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William Cline Borden, M. D., F. R. M. S.
CAPTAIN, MEDICAL DEPARTMENT, U. S. ARMY.

WITH FRONTISPIECE.

Dr. Borden was born in Watertown, N. Y., May 19, 1858. His ancestry is American since 1635 when Richard Borden, known in the family annals as "The Emigrant" emigrated from Borden, Kent County, England, and settled at what is now Portsmouth, Rhode Island. From there his direct ancestors moved to New Jersey, where the family name is perpetuated in the town of Bordentown, and thence to New York.

His early education was in the public schools, later he entered the Hungerford Collegiate Institute at Adams, N. Y., and there pursued an elective, academic and scientific course.

In 1879, he began the study of medicine and March 15, 1883, he received the degree of M. D., graduating from the Medical Department of the Columbian University, Washington, D. C. A few months later he passed the examination required for admission to the Medical Department of the United States Army and December 3, 1883, he was given a commission as Assistant Surgeon with the rank of First Lieutenant. His first service was in the Department of the Platte at Fort Bridger, Wyoming, then at Fort Douglas, Salt Lake City, Utah. In 1888 he was transferred to the Department of Texas and promoted to the rank of Captain. He remained in Texas until 1891, serving at San Antonio, Fort Ringgold and Fort Davis, when he was ordered to Jackson Barracks, New Orleans, Louisiana. While on duty there he was sent

in 1892 for temporary duty with the community of Apache Indians held as prisoners at Mount Vernon Barracks, Alabama, and for his sanitary work with these Indians he was commended in the Annual Report of the Surgeon General of the Army for that year. Owing to the high death rate of these Indians from tuberculosis, he became interested in their vital statistics and published a paper in the Boston Medical and Surgical Journal entitled "The Vital Statistics of an Apache Indian Community" in which their statistics for five years were compiled, and which is of interest as probably being the only accurate vital statistics of an indian community ever published.

From New Orleans, Dr. Borden was transferred to Fort Adams, Newport, Rhode Island, and from there to his present station, Fort Snelling, near St. Paul, Minnesota.

Dr. Borden first began work in Microscopy when attending his first course of medical lectures. At that time a three years graded course of study and practical work in histology and pathology were required but in few of the medical colleges of the United States of which the Columbian University was one, and as he became interested in microscopical work, the graded course gave him more time to follow his studies in that line than was available to the average medical student. After entering the Medical Department of the Army he continued his microscopical work and soon began work in photomicrography.

He is the author of a number of monographs on subjects connected with general and military medicine, histology, microscopical technique, photomicrography, and photography, and he is a member of the Associations of Military Surgeons of the United States, and a Fellow of the Royal Microscopical Society of England.

A Simple Means of Comparing the Apertures of Objectives.

By R. B. L. RAWLINGS,

NASHVILLE, TENN.

While the subject of aperture is of interest to every worker who prizes his objectives and wishes to understand their exact capacity, the high price of the Abbé Apertometer leaves the great majority of microscopists without a means of determining aperture.

From numerous tables which have been published comparing the actual aperture of lenses with what is claimed for them, it is seen that in many instances the performance of the objective cannot be what is claimed for it.

A search amongst the catalogues at hand of several of the leading opticians of the world fails to show an apertometer of any description listed in any of them, with the single exception of the Abbé, listed by Zeiss.

While the idea of the arrangement in the experiment below detailed is suggested from a study of the Abbé form of apertometer, it is essentially different in half the technique.

For the benefit of those who are not familiar with the instrument and in the hope that I may make the proposed modification plainer, it may not be amiss to attempt a short explanation of its working, particularly as this is not done in the Zeiss catalogue.

It consists essentially of (a) an auxiliary objective and (b) the plate glass semicircular and prismatic disc.

The objective has a focal distance of about 3 inches, is mounted with a society screw and has screwed in the upper part of the mounting a cylinder with a small diaphragm in its upper end.

This objective is to be screwed into the lower end of the draw tube after the objective to be examined has been focussed on the disc, care being used not to disturb the focal arrangement of the objective in the nose piece. Its purpose is for the reading of the indices. The draw tube

thus equipped is the auxiliary microscope.

The disc (b) is of plate glass and is placed on the stage of the microscope. It is semicircular, with the semicircular margin vertical and polished, as are all its surfaces; the back edge is ground at an angle of 45° , base of the prism upwards.

The upper surface has two sets of graduations on it, the outer circle being for numerical and the inner for angular aperture. Corresponding to the centre of the circle is the small perforated silvered disc, mounted under a cover glass, and through which the *image* of the indices is observed. Over the right-angled margin of the semicircle, slide two L shaped indices so made as to hang on the upper edge of the disc and lie against the vertical margin. The light horizontally striking the vertical edge of the plate glass disc projects the images of the indices on the margin in such a manner that they appear to lie horizontally along the diameter of the semicircle directly under or to the right and left of the objective according as they are moved.

The indices are brought near the centre of the margin of the semicircle, and by sliding the draw tube up or down within the body tube (care being taken not to alter the focus of the objective to be measured which has been focussed on the centre of the silvered perforated disc previous to attachment of auxiliary objective to draw tube) a sharp image is obtained of the indices. They are then moved around one on each side, until their points are barely visible within the circle of light. The reading is then made direct from their inner edges in numerical or angular aperture as desired.

For the experiment herein detailed, a substage condenser and iris diaphragm are necessary accessories, although one may proceed in a crude and unsatisfactory way without the latter.

The objectives whose apertures are to be compared, are

to be examined, beginning with the lowest angled ones and proceeding upwards.

With the tube length corresponding to the correction of the objective if it is non-adjustable, focus the objective to be examined on the upper surface of the condenser. Pressing the body tube against the rack to prevent alteration of the focus, unscrew draw tube adapter and remove draw tube. Into the lower end of the draw tube screw a 3-inch objective. Replace draw tube in proper position. This forms the auxiliary, observation or draw tube microscope, and is for observing an image at its focal distance through the objective under observation as a medium admitting divergent rays of light, and not as an objective.

Reduce the aperture in iris diaphragm of substage to lowest size. Pressing body tube against rack as before to prevent alteration of focus, focus the draw tube by sliding it in the main tube sharply on opening in iris diaphragm. Then open diaphragm until only a glimpse of its margin can be seen. The diameter of the opening thus obtained is in direct ratio to the angular aperture of the objective. Leaving the diaphragm as it is, repeat the experiment using the next higher objective at hand, remembering in every instance to remove the draw tube objective and focus the one to be examined on the top surface of condenser. In the second instance, after the draw tube microscope has been focussed on the diaphragm, a margin will remain. Increase opening as before until only a line of the margin of diaphragm is visible.

The experiment may be repeated on higher powers until the angle of aperture of the condenser system is reached or approximated.

While any great alteration in the focal distance of objective under observation will cause an appreciable error in the comparison, a considerable range is allowable without perceptible difference. Thus the experiment may be much simplified and yet retain its accuracy by making

one insertion of the objective in the draw tube answer for the examination of all the objectives, without its having to be removed for each time. The auxiliary objective is put in position, the one to be examined is put in the nose piece and its focal distance approximated, which can usually be done pretty nearly by one familiar with the objective.

While in these experiments no real figures can be gotten at, it is easily within the power of the maker to supply them with high class instruments at a very moderate price. All the other tests of an objective are within easy reach of the worker, why should not this supreme test of its workmanship also be within his reach?

The principle that the maker can take advantage of is this. The position of the knob which regulates the supply of light through the diaphragm is of course directly relative to the size of the opening.

Fitted over the outer collar of the diaphragm may be attached a plate extending forward two inches, being rounded to an arc of 80° — 90° , with a radius which would be about 3 inches. In place of the knob used to regulate the opening, an index pointer is screwed in place. The arc is so graduated as to indicate the aperture of the objective when the iris diaphragm has been viewed and arranged as above stated.

While for the ordinary worker the problem of graduating this arc might be very difficult, owing to the fact that very accurate measurements must be made of the diaphragm opening, the refraction of light through two kinds of glass with a spherical triangle of air interposing, the radius of the part of the condenser used, to be determined, etc., to the practical optician such calculations are easy enough.

White's Objects.—The Central Board of Education, Fifth Avenue High School Building, Pittsburg, Pa., has just purchased 80 White Objects for use of the department of biology, Ed. Rynearson, teacher.

The Value of Peroxide of Hydrogen in the Preparation of Entire Insects.

BY CHARLES E. HANAMAN,
TROY, N. Y.

The use of peroxide of hydrogen in microscopical technic has, in so far as I am aware, been limited to the bleaching of sections which have been blackened by osmic acid or stained green by chromic acid hardening agents and for the rapid ripening (by oxidation) of haematoxylin staining fluids.

The usual method of preparing entire insects has been to remove by the use of caustic soda or potash all of the soft parts, the resulting preparation consisting only of the exoskeleton. Such preparations are useful for the study of the sclerites, but it has often seemed to me desirable to make preparations which would show the relation of the muscles and the viscera to the sclerites, while all the parts remained *in situ*. Such specimens would be especially useful for comparison with sections and dissections of other specimens of the same insect.

The dark, and often times opaque, color of the chitin composing the exoskeleton has heretofore prevented the successful making of preparations of this kind from the majority of insects.

Searching for some method by which the opaque chitin might be rendered transparent without injury to the contained soft parts, I happened to think of peroxide of hydrogen and I believe I have found in it the reagent I was seeking for.

To illustrate its use, and perhaps at the same time to aid some beginner to make preparations suitable for the study of insect anatomy, I have detailed below the preparation of a common house-fly; it being the insect upon which the discovery of the usefulness, in this connection, of the peroxide was made.

Permit me to state here, that my microscopical studies are subject to frequent and sometimes to long continued interruptions from business causes, and that nearly all of

my work is done in the evening, so that the intervals between the operations, described below, are often due to such interruptions rather than to their being necessarily required by the process. I do not think, however, that anything would be gained, in the present instance, by shortening any of the intervals given below.

The fly was placed under a bell-glass, together with a piece of blotting paper which had been saturated with chloroform, and the moment the insect ceased to move, it was dropped into a small beaker of boiling water, the lamp by which the water was heated, being withdrawn the moment the insect entered the water; this was done for the purpose of killing and fixing the soft tissues, heat being the only successful reagent for this purpose, excepting in cases where the chitinous integument can be slit up so as to allow the entrance of a liquid fixing agent, no fixing agent excepting heat being known which will penetrate through chitin with sufficient rapidity to fix the enclosed protoplasm before post-mortem changes have begun. The moment the fly, which was a female, entered the water the proboscis and the ovipositor were fully protruded and extended, and remained so during the succeeding manipulations.

The insect was left in the hot water for about five minutes and was thoroughly washed in it. It was then placed upon a small piece of glass (about one half of a mounting slip) and the legs, wings, etc., were arranged so as to afford the best display, another piece of glass of the same size and shape as the first was placed over it, but prevented from pressing upon the specimen, more than just enough to hold it in place, by bits of glass, of the proper thickness, being inserted between the ends of the two plates; the whole was then bound together by means of thread wound around them and dropped into a jar of 30 p. c. alcohol which was changed, with intervals of twenty-four hours between each change, to 40 p.c.—50 p.c.—70 p.c.—80 p.c. and 95 p.c. strength.

After a stay of several days in the alcohol the thread was taken off and the fly washed in fresh alcohol, from which it was transferred to a slender dish containing 18 parts of 95 p.c. alcohol and 2 parts of peroxide of hydrogen, from a freshly opened bottle of Marchand's solution.

At the end of 24 hours, immersion in the solution the abdomen of the insect had whitened somewhat; after another 24 hours the thorax and the head had bleached perceptibly and the eyes were seen to be losing their red pigment. The specimen was now left for 48 hours longer, and at the end of this time, 96 hours from its first immersion in the peroxide solution, the whole insect was as white as chalk.

The specimen was then rapidly washed in strong alcohol and placed for complete dehydration and staining at the same time, in 95 p.c. alcohol to which had been added 1-20 p.c. of eosin, this staining agent being the one recommended by most authorities for staining through chitin on account of its great power of penetration. After remaining for 24 hours in the alcohol-eosin bath it was rinsed in fresh alcohol and placed in xylol to clear. In an hour's time the whole structure had cleared perfectly and the specimen was mounted in xylol-balsam in a zylonite cell, and presented a most beautiful and interesting appearance under the microscope.

The chitin had been rendered almost as transparent as glass, the eosin had given it a faint rosy tint while the spine like hairs were more darkly stained; through the transparent but very evident exoskeleton were to be seen the muscles and their attachments and much of the viscera; the abdomen was seen to be filled with eggs, arranged in two rows along each side of the median line of the dorsum, the embryos within the eggs were clearly visible, the chitinous egg-shells having been rendered very transparent, permitting much of the detail of the protoplasmic structures within to be seen.

Studies in the Elements of the Anatomy of the Lower Vertebrates.

By HENRY LESLIE OSBORN,
HAMLINE UNIVERSITY, ST. PAUL, MINN.

PART II.

THE TAILED AMPHIBIAN.

Amblystoma tigrinum, The Salamander.

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[This description is drawn directly from *Amblystoma tigrinum*, a species that is abundant in the outskirts of Saint Paul, especially in the Autumn months during damp weather. It will apply to any of the urodeles well enough for the purposes of a guide; and can be used for the frog, though with considerable modifications, especially for the skeleton of the body.]

1. **EXTERNAL ANATOMY.**—The characteristic external features as found in the higher vertebrates are readily seen, viz: a division of the body into *head*, *neck*, *trunk* and *post-abdomen*; the presence of an *anterior* and a *posterior* limb. Examine these and note in each three principal regions: *upper*, *middle* and *lower* which are similar in all but not precisely the same. Of the front limb the upper region is called the *brachium*, the middle the *antebrachium*, and the lower the *manus* which is again divided into: the *carpus* or *wrist* and the *digits*. The hind limb in a similar manner presents: the *thigh*, the *crus* and the *pes*, which is divided into the *tarsus*, and *digits*. How do these regions compare as to length? What differences do you find between the *manus* and the *pes*? How do the limbs compare with those of the frog? Do you recognize the

same regions in the limbs of all the vertebrates? Note that the *shape of the body* is that of a fish as to the post-aldomen which is compressed and used in swimming when the animal is in the water, while anteriorly the head and to a less degree the trunk are flattened from above downward, in relation to terrestrial life. Study the *distribution of color* noting the general naked skin black in color, with yellow spots; note that in some cases the patterns of the right and left sides seem to abruptly stop in the middle dorsal line. In the larger specimens there are no traces of median fins but in younger specimens even though they have attained considerable size and are living on land there are sometimes decided indications of the dorsal fin; and in occasional large specimens there are decided vestiges of gills. If it is possible you should observe the locomotion of the animal: on land by running on the legs with extreme bendings of the body in the same lines as in swimming: in the water commonly by walking but when excited by swimming, in which case the limbs are entirely unused. Compare the external form with that of other vertebrates, as you did in studying the fish.

2. THE HEAD is divisible into a *cranium*, which hardly appears externally; and the *face*, which both in front and on the side and below composes the bulk of the head. Note the rounded front and broad flat hinder part of the head and the very large *gape* of the mouth which literally opens from ear to ear. Observe and locate the two nostrils *anterior nares*; cut away the skin behind one and find the *nose chamber*; explore its boundaries, note its smooth mucous lining, *olfactory mucous membrane*; and in the outer and hinder angle note the *posterior nares*; pass a bristle through this and note that it emerges in the mouth chamber. Examine the eyes, as to location, size and shape. Do you find *lids*? Cut away the surround-

ing tissues and display the *eye-ball*; recognize the various parts and compare them with those of the smelt. Cut away the skin and muscle from the dorsal hinder surface of the head. You will thus be able to find the bony *brain-case* in the middle and hinder part, and on either side behind a lateral bony extension lodging the *ear-capsule*. From this the bones of the upper jaw run forward to meet in the middle line in front.

The lower jaw articulates with the upper near the ears. The *ear* does not show externally in the salamander but it does in the frog in the form of a rounded piece the *tympanum*. Cut into the ear capsule and you will find some of the parts of the ear, for a detailed description of which a more extended work must be consulted. Open the mouth widely and examine its interior. Are there any teeth? If so where and of what form and number? Note the large and fleshy *tongue*, what is its shape and mode of attachment? The narrow slit back of the tongue is the *glottis* it leads into the wind pipe. Note at the back of the mouth chamber the opening of the *gullet*; as in the fish there is *no distinct throat*. The hinder part of the mouth chamber is the equivalent of the throat; and in younger specimens its walls are perforated and allow water to pass out over gills which at that time are present and used for respiration as in the fish. (In some urodeles the gills and fins persist through life e. g., *Necturus*).

3. THE BRAIN.—Cut away the cranial bones dorsally, noting that they form a thin layer covering a capsule of cartilage which immediately encloses the brain. In removing the bones to display the brain be very careful not to injure the latter. The situation of the brain should be first noted in the hinder part of the head; its relation to the sense organs should be ascertained and the facts recorded. Study the different principal parts

of the brain comparing them with the fish as you progress. The *medulla oblongata* is most posterior and is seen to be a continuation of the tissue of the spinal cord. On its dorsal side there is a considerable open space. Crossing which and in front of it is a narrow *cerebellum*. Directly in front of these is a rounded mass (apparently single but really paired) the *optic lobes*; and in front of these again are two elongate masses the two *cerebral hemispheres*. They are attached behind through the *crura cerebri* which run under the optic lobes to the medulla; there is no transverse nervous connection between the two hemispheres (*corpus callosum* of the higher vertebrates). In recognizing these parts you will probably see some of the cranial nerves running from the brain chiefly from the medulla to various parts of the head.

4. THE BODY CAVITY.—Locate the wall of the body cavity. It is limited posteriorly by the cloaca, behind the level of the hind legs. Note the regular cross foldings in the side wall of the body; they are indications of the limits of the sets of muscle fibres in the wall, and are perhaps homologous with the *myotomes* in the fish. Cut the wall of the body cavity open and find the cavity within, draw the skin aside and note the pigmented *peritoneum* which lines the space. Follow the cut forward and as you reach the level of the front limbs note and dissect out the two pieces of cartilage which overlap in the midventral line, they are the *coracoid cartilages*. Draw them aside and pin them out of the way. They will be studied latter in connection with the front limb.

Cut away the coracoid cartilages and continue to open the body cavity forward to the throat. Follow it backward toward the cloaca, in doing so you will come to a similar ventral arch helping to hold the hind leg in place; note that it is bony, dissect off the muscles and skin so as to disclose the pair of bones, and cut between them;

push them aside and pin down, so as to fully open the cavity. Note that there is *no diaphragm* subdividing the body cavity into thorax and abdomen; note also the *mesentery*, its thin delicate texture, and its continuation out onto the body wall where it passes insensibly into the *peritoneal lining*. In dissecting the contents of the body cavity do not cut any of the organs away, till after you have located and examined the relations of them all; merely dissect them apart, and push them aside to see underlying ones. After all the points have been noted you can then cut out such as are necessary.

5. THE HEART is located in the neck very close behind the head; it is next the ventral body wall and in front of the level of the anterior limbs. In the construction of its interior it is also intermediate between the single circulation type as in the smelt and the complete double circulation of the bird or mammal. Remove the *pericardium*; this will enable you to see the different parts of the *heart* and some of its large *communicating vessels*. There is in front a pair of *aortic arches* which lead out from a distinct *bulbus arteriosus*. Posterior to the bulbus is the *single ventricle*, it lies on the right side and somewhat ventrally to the auricles. There are two auricles; the veins from the body at large empty into the *right auricle*; the blood from the lungs empties into the *left auricle*. If the specimen is in a suitable condition cut the chambers open and using a probe carefully trace their connections both with each other and with the large communicating blood vessels. Both auricles open into the single ventricle (but in such a manner as to send the best aerated blood to the head, and the poorest to the posterior parts of the body).

[6. THE VASCULAR SYSTEM,—can only be adequately dissected upon an injected specimen, but an outline description is included here for convenience and a good

many of the vessels can be found. A single pair of *aortic arches* pass dorsally from the bulb and meet, as in the fish, to form the *dorsal aorta* which then runs down the body cavity in its dorsal wall and beyond into the post abdomen. Partial additional arches can be traced (in the frog) which lead out from the bulbus to the head *carotids* and to the lungs *pulmonary arteries*, *sub-clavians* pass from the dorsal aorta into the arms; in the trunk region there are *coeliac*, *mesenteric* and still more posteriorly *renal* arteries; at the level of the hind limbs there are *iliac arteries* going into them from the dorsal aorta; there is an artery running in the skin *cutaneous*, it arises from the subclavian and also from the iliac. Veins from the kidneys *renal veins* combine to form a vessel the *post-caval vein* (posterior vena cava) which runs close below the back-bone directly forward and into the hinder side of the right auricle. It receives vessels from the liver, *hepatic vein*, but none from the stomach or intestines. The blood from the iliac system, and muscles and skin of the post-abdomen is collected into a vessel of importance in the amphibia but of minor significance in the higher vertebrates, the *anterior abdominal vein*; it runs in the mid-ventral line closely related to the skin there, and enters the hinder side of the liver where its capillaries anastomose with those from the portal vein. The blood from the anterior parts of the body returns to the heart through *jugular* and *sub-clavian veins*, which contribute to form the *pre-caval vein*, entering the right auricle. Thus all the systemic blood is returned to the right auricle. The blood from the lungs, is returned to the left auricle by *pulmonary veins*.]

7. THE ALIMENTARY VISCERA.—The *liver* is the most noticeable organ of the system; it lies in the mid-ventral line directly behind the heart, and reaches back more than half way down the body cavity. On its posterior

border the *gall bladder* can be seen. By drawing the liver aside, the *gullet* can be seen dorsally to the heart; the *stomach* is a fusiform enlargement in the course of the alimentary tube which passes insensibly into the *small intestine*. The latter is somewhat longer than the body cavity and hence is winding in its course; the *mesentery* can be seen clearly on its dorsal side and *portal vessels* are recognizable. At the upper end of the small intestine you can find the *bile-duct* running into it from the gall-bladder; and in the mesentery near by there is a diffused mass of *pancreatic tissue*, whose ducts open into the small intestine. The *large intestine* directly follows the small intestine, is not sub-divided into parts but has the form of a short rectum passing directly to the *cloaca*.

8. THE LUNGS are a pair of elongate, slender thin-walled sacks; blind posteriorly, they come together in front and above the heart where they open into a passage which leads to the *glottis* already noted in the hinder part of the mouth chamber just behind the tongue. In the higher vertebrates this air tube (*trachea*) is lined with cartilage, but it does not appear to be so in the salamander. The passage can be demonstrated by passing a guarded bristle down through the glottis. The lungs should be cut open to show that the interior is a very simple sack with only a beginning of that elaborate subdivision into spaces found in the mammal. The walls are reddish, this indicates the presence of blood vessels in contrast with the colorless wall of the swim bladder of the smelt; but to prove that the wall is vascular mount a thin film of it and examine with the compound microscope. Do you find any blood corpuscles there?

[This and the reptilian lung are simple conditions of the lung of which the bird and mammal lung are very highly specialized conditions. The circulation and respiration

of the adult amphibian are decidedly different from that of the young: in the latter the blood is pumped through gills and thence directly to the body, as in the fish so that the circulation is a "single circulation," with the loss of the gills after the maturity has been reached the double circulation, and respiration as here described, are established. In reptiles, birds and mammals the same is true of the circulation but in their cases the single circulation is confined to stages that precede free and independent life, i. e., are purely embryonic. (In some amphibia e.g. *Necturus* respiration is both pulmonary and branchial throughout life.)

9. THE URO-GENITAL SYSTEM.—Cut off and remove the various viscera already examined (after making drawings necessary to record the facts) taking care not to damage the remaining organs in the body cavity. The reproductive organs vary considerably with sex and season. In the breeding season the ovaries are filled with black eggs which are greatly in the way in dissecting, and the oviduct is much enlarged by the formation of the large amounts of albuminous matter in which the eggs are "laid." These latter will not of course be confused with the alimentary tube by a careful dissector. The paired kidneys are divided into two parts: a hinder portion of more compact texture *meta-nephros*, lying near to the cloaca and next the dorsal body wall; and in front of this a long *mesonephric part* which runs forward on either side and reaches the anterior level of the body cavity, close to the dorsal body wall. There is a *urinary bladder*, it is thin-walled, and located below the rectum between it and the body wall, in the most posterior part of the body cavity. Its size varies greatly in different specimens. Ducts (*ureters*) from the kidneys lead into it and there is a passage *urethra* leading from it to the cloaca.

The *ureters* pass down on the outer side of each meso-

and meta-nephros; in some cases they are very conspicuous; they unite below the meta-nephros to form a single passage which leads into the bladder on each side. In the higher vertebrates the kidney is a compact organ and the ducts coming from its various parts all unite to form the single ureter before they leave the boundary of the organ.

The *spermary* in male specimens is a compact organ on the level of the meso-nephros; its ducts pass into the ducts from the meso-nephros and thus reach the exterior through the ureter*; in the female there is a duct *ovi-duct* which lies beside the ureter, and is separate from it, this runs way forward to the neck where it opens by a broad funnel shaped orifice directly into the body cavity; near this opening of the ovi-duct lies a large glandular organ the *ovary*, the ova when they escape from the ovary find their way into the oviduct at its open end and then collect there to produce the appearance described in the beginning of this paragraph. They finally escape through the cloaca into which the ovi-duct ultimately opens.

10. THE MUSCULAR SYSTEM.—The skin should be removed from the body and at least one of the limbs to determine the following points; the muscle fibres will show much more distinctly after preservation in alcohol or after boiling. The system as a whole includes: the muscles connected with the viscera *involuntary muscles*; and the muscles attaching to the skelton and used in changing the form and position of the body, *skeletal muscles*. Of these latter we may distinguish those of the *head*, and those of the (rest of the) *body*. It is to the latter that the present study is mainly confined. Two kinds are reconizable: those of the spine used in producing the bendings of the back-bone, *spinal muscles*; and

*Besides the spermary there is generally in the males a organ on each side resembling it but composed mainly of fat called the corpus adiposum.

the *limb muscles*. The spinal muscles are plainly homologous with those of the teleost; for they are similarly located. In the post-abdomen they make up the bulk of the flesh and are closely related to neural and haemal spines; and in the trunk they are related to neural spines dorsally while ventrally they compose a large portion of the wall of the body cavity. They are also segmented, each myotome being made up of short fibres parallel in their arrangement and corresponding precisely with the number of the vertebrae. The limb muscles are relatively insignificant in the salamander whose limbs are small, though really much used, but they are homologous with the very important limb muscular system as it exists in its highly elaborate state in the mammals. The exact identification of the muscles of the limb will hardly be possible in this course, but a number of points can be made out. The muscles are seen to consist of a muscular central portion the *belly*, and at the end a *tendon* which in some cases is quite long.

The muscles have two points of attachment, one the *origin* nearer the back-bone; a distal one the *insertion* farther from the spine. The shortening of the muscle causes it to pull on its tendon and thus to move the bones on their joints. The muscles are placed on opposite sides of the limb so that some bend or *flex* it, while others *antagonize* these and *extend* it again.

11. FINE STRUCTURE OF STRIATED MUSCLE.—Cut out one of the small muscles of the limb, place it on a slide, surround it with glycerine, tease it carefully into its component fibres, taking care not to twist them; after spreading the muscle out as well as possible, cover and examine with a low power. You can now recognize more clearly that the organ is made up of parallel short pieces, imbedded in a network of minute fibres of *white fibrous connective tissue*; trace these latter toward the *tendon* and

note that they alone compose it, the muscle fibres disappearing at the end. Examine single fibres with a high power, and recognize, that they are composed of still smaller *fibrillae* which run lengthwise in the fibre; that there is a sheath enclosing the fibre, *sarcolemma*; that the fibrillae are marked with lines crossing them at equal distances, and that this gives to the fibre a cross-marking, *striation*. Directly beneath the sarcolemma there are elongate granular *cell-nuclei*, these may not be easily recognized in the glycerine preparation unstained. If so stain a second preparation before the application of glycerine with borax carmine, decolorize with acidulated alcohol and examine small fibres for nuclei, note their exact size and position with reference to the fibre.

12. THE NERVOUS SYSTEM.—In dissecting the dorsal wall of the body cavity next the spinal column you have probably noted white threads running in the lines between the myotomes outward from the spine, these are the *spinal nerves*. A pair can be seen at the interval between each two vertebrae through the entire length of the trunk, and they are also present in the post-abdomen in the same way, though not there so easily traced; there is thus a metamerism in the nervous system. The spinal nerves are of approximately the same diameter throughout the series excepting at the levels of the front and hind limbs, where several of them are considerably larger than the rest, this is because they are composed of the additional fibers that go to the muscles and skin of the limbs. How many of these nerves to the limbs do you recognize? In the head there is a series of *cranial nerves* which relate the parts of the head with the brain; as in the fish, the spinal canal lodges the *spinal cord* which can be seen by removing the neural arches. There is a *sympathetic system* but its dissection is very difficult.

13. THE AXIAL SKELETON.—After setting aside the limbs, clean the back-bone in a specimen which has been boiled to soften the muscular tissue, removing all the flesh by picking it away or with a brush. Take care not to dislocate the bones and especially not to loosen the very rudimentary ribs in the trunk region.

Note the series of vertebræ running from the head to the tip of the tail. They are less similar in different parts of the column than in the fish; being differentiated into regions to some extent though less markedly than in the birds and mammals. In the neck *cervical* region, an *atlas* articulating with the skull and an *axis* next behind the atlas are present. Behind these come the vertebræ of the *trunk*, which correspond with the *dorsal* and *lumbar* series of mammals; a single *sacral* vertebra follows and to it the pelvic girdle is attached; this in turn is followed by the *caudal series*. Count the number in each of the regions and compare with other individuals to determine the degree of constancy of the number.

Any of the trunk vertebræ can be examined as a representative case. It presents a *centrum*; a *neural arch*, bearing a spine and the *zygapophyses*; a bi-furcated *transverse process* is carried by the centrum on each side; to which the rib when present is articulated. Transverse processes are wanting in the *atlas* and *axis*; and the neural spine is unlike that of the rest of the series; the axis bears a prominence in front of its centrum, the *odontoid process*. The sacrum is like the others but has much enlarged transverse processes. The caudal series is much compressed; there is a series of *chevron bones*, the *hæmal spines*; and the accessory parts gradually fade out and disappear posteriorly till nothing but the centrum is left. *Ribs* are present articulating with vertebræ in the neck as well as in the dorsal and lumbar regions, so that the differentiation as in the mammals is not found here; the ribs are rudimentary and do not run out onto the body

wall to any considerable distance. Compare this skeleton if possible with that of a dog, cat or any other mammal.

14. THE SKELETON OF LIMBS.—Remove the skin and muscular tissue so as to display the bones of the limb and note the position size and shapes of the bones as follows. The front limb is not directly articulated to the body but at the *shoulder joint* to a plate of bones and cartilage forming the *shoulder girdle*, this consists of two portions: one is dorsal, the *scapula*; it consists of a small elongate bone dorsal to which is a cartilaginous plate the *supra-scapula*, the other on the ventral side is a large plate of cartilage which meets and overlaps its mate of the opposite side, *coracoid cartilages*. These each present a broader hinder *coracoid* proper and a smaller anterior *pre-coracoid*. In the hinder angle between the two coracoids a small *sternal cartilage* is found. These elements of the *shoulder girdle* meet and form a cup-shaped *glenoid* cavity into which the bone of the upper arm is articulated. There is a single bone the *humerus* in the upper arm. In the middle-arm there are two bones, one the *radius* on the inside, the other the *ulna* on the outside of the arm. There are four digits in the hand which correspond with the outer four in the human, examine them and locate and count the small bones *phalanges* of which they are composed. Carefully dissect the wrist region and find the small *carpal bones*, determine that there are two rows: one *distal row* at the bases of the digits; and a *proximal row*, articulating with the end of the radius and ulna. As the bones of the carpus are similar in all the vertebrates their nomenclature is given here. Three are recognized in the proximal row, viz: *ulnare*, *intermedium* and *radiale*; four in the distal row viz: *carpalia* 2, 3, 4 and 5 articulating with the digits 2, 3, 4, and 5 (the first being abortive). One more in the centre of the carpus the *centrale* complete the list.

Dissecting in the same way the hind limb, determine its various bones. There is a *pelvic girdle* attaching the limb to the body; this is directly articulated with the spinal column, the point of attachment being on the sides of the *sacrum*. There is a cavity *acetabulum* into which the upper limb bone of the leg fastens, formed by three bones passing: one dorsally the *ilium*: a second ventrally and in front, the *pubis*; and a third ventrally and behind the *ischium*; all three meet in the acetabulum. The two ventral bones meet in the mid-ventral line and compose an arch, the pubic arch, between which and the back-bone the rectum and the uro-genital organs pass to reach the cloaca.

The *femur* is the single bone of the upper limb *thigh*. In the *crus* there are two bones, *tibia* and *fibula*; they are of the same size; the outer is the fibula; there are *five digits*, locate and count their bones; examine the tarsus, it has the same composition as the carpus, i. e. a proximal row, *tibiale*, *intermedium* and *fibulare*, centrale and distal *tarsalia* 1, 2, 3, 4, and 5.

15. THE BONES OF THE SKULL.—The skull of the salamander is somewhat small for study of the bones and that of a large frog is much the same and should be used in its stead if obtainable. The brain case is enclosed below by cartilage, *sphen-ethmoid*, which in the higher vertebrates ossifies in two parts: the *sphenoid* bone behind and the *ethmoid* bone in front. Dorsally, the brain is covered by the *frontal* bones in front and the *parietal* bones behind. Below the sphen-ethmoid cartilage is a dagger shaped para-sphenoid bone (not found where the sphenoid and ethmoid are ossified). At the hinder end of the brain-case the nervous tissue emerges through an opening the *foramen-magnum*; this is the *occipital region* of the skull but remains cartilaginous in amphibia except where it articulates with the spinal column, here bones

the *exoccipitals* are developed. Bones reach out from the brain-case and support the different parts of the face, posteriorly are the *auditory capsules* surrounding the ears; when bones are developed in this cartilage they are called *otic* bones and in the frog *pro-otics* are formed on the anterior side of the cartilage. A mass of cartilage *quadrate cartilage* reaches from the occipital region sideways as far as the angle of the jaw. A bone the *pterygoid* ossifies in connection with this. It reaches forward and helps to form the upper jaw. It also rests against the sphen-ethmoid cartilage.

Another bone related to the hinder part of the skull is the *quadrato-jugal*, this forms the hinder outer angle of the head, and the *glenoid cavity*, where the lower jaw articulates, is located in it. The arch running forward from the quadrate forming the hinder part of the upper jaw is called the *zygomatic arch* the space between it and the brain case is the *orbito-temporal fossa*, and lodges the eye, in front and the *temporal muscles* (used in closing the lower jaw) behind. Continuing on the line of the upper jaw, you will find next in front of the zygomatic arch a slender portion of the *maxillary bone*. This bone presents two other portions; one on the roof of the skull and behind the nostril, the *facial portion*; and a second part which runs in and forms a part of the roof of the mouth chamber, in front, the *palatine portion*. The middle of the upper jaw is formed by the *pre-maxillaries*, which also form the lower border of the nostril. The *nasal bones*, run from the premaxillaries to the frontals in the middle line of the roof of the skull, and are located posterior to the nostrils. Small bones, the *pre-frontals* complete the closure of the nostril. In the roof of the mouth there are in front two large flat bones, *vomers* and crossing the capito-temporal fossa. Between the vomer and the maxillary are the *palatines*. The lower jaw is composed of cartilage in early stages but in adults a number of dif-

ferent bones are formed in the membranes which invest this original *Meckel's cartilage*, often however leaving some remnant of the cartilage even to the very end of life. Of these the *dentary* is the central one bearing teeth, the *angular* the one bearing the articular face and meeting the quadrate.

EDITORIAL.

Peroxide of Hydrogen.—We are very glad to call attention to the article of Mr. C. E. Hanaman on pages 7, 8 and 9 describing his experiments and the use made of the peroxide. We trust that others will report upon the use of this antiseptic. In his letter transmitting the article Mr. Hanaman writes: "Altogether the specimen is one over which many hours of profitable study may be spent, and I trust that this article may induce others to experiment in the same direction, and if possible improve upon the process. I do not think the bleaching process can be very much improved but there is ample field for experiment in the direction of fixing fluids with penetrating power sufficient to pass quickly through chitin and of selective staining agents with the same powers.

Microscope Wanted.—One of our subscribers (W. C. P.), wishes to buy an instrument,—student's Van Heurch preferred. Send offers marked "No. 1290" to us for his consideration.

Barbados Earth.—We have a small quantity left of the supply of Barbados earth so kindly given to us, for distribution, by Mr. Bryce Scott of New Brunswick. Send stamped envelope.

Richard H. Oakley, 2227 Wilson avenue, Cleveland, Ohio, has slides of Sycamore, double stained which he wishes to exchange for slides of diatoms, ferns or mollusca odontophora.

MICROSCOPICAL APPARATUS.

Attachable Mechanical Stage for Microscopes With Plain Stages. This Stage consists of a suitable base-plate provided with thumb-screws fitting into the clip-holes and fastened from below. Upon the base-plate are two sliding

MECHANICAL STAGE.

pieces mounted at right angles to one another and moved in right lines by two milled heads. The perpendicular movements are controlled by rack and pinion, and extend an inch and a quarter. The horizontal movements extend full two inches and are controlled by a micrometer screw. These sliding pieces pass along suitable scales whereby

any particular position may be recorded and found again easily. The object is in a simple carrier close to the surface of the stage. The mechanical stage can be fitted to any stage if the location of the clip-holes and center of the stage is known. It is sold by Zentmayer for \$16.00.

MICROSCOPICAL MANIPULATION.

To Distinguish Guaiacol from Beechwood Creosote.—Mr. Vreven utilizes the following method for distinguishing beechwood creosote from liquid guaiacol: He places a few drops of the substance under examination in a test tube and adds 2 or 3 drops of ether and 1 or 2 drops of concentrated nitric acid or of concentrated hydrochloric acid and agitates the mixture. There is first of all a reddish brown coloration produced in the ethereal layer. After spontaneous evaporation of the ether there remain oily drops if the substance on examination is creosote, or if it is liquid guaiacol the residue is in the form of crystals. Sometimes crystals are not produced even if the substance examined is liquid guaiacol unless the residue is agitated, but upon agitation the crystals appear immediately. Under the same conditions carbolic acid also yields crystals, but their form does not at all resemble the form of crystals produced by guaiacol, the crystals of the latter consisting of needles aggregated in the form of stars which are very easily distinguished under the microscope.—American Druggist.

New Method of Purifying Water.—The French Academy of Sciences appears to indorse the new method of purifying water by calcium permanganate and manganese dioxide. According to this method, the calcium permanganate coming in contact with organic matter and microorganisms, destroys them and decomposes itself into oxygen, manganese oxide and lime. Then, to carry off the surplus of permanganate and complete the purification, the water is poured over manganese dioxide; oxygen in the nascent state is thus freed and it burns up any remain-

ing germs. There remain in the apparatus, then, inferior oxides of manganese, which hasten to re-oxidize themselves and furnish again a certain quantity of manganese dioxide; the water as thus finally purified contains a little lime in the form of bicarbonate and traces of oxygenated water. A very small quantity of calcium permanganate is used in this process, and, if practicable on a large scale, is of great importance. Water having 100,000 colonies of microbes can thus be purified, it is stated, and ice placed in water with calcium permanganate is also quickly sterilized.—American Druggist.

BACTERIOLOGY.

The Microbic Character of Acute Catarrhal Otitis Media.—Lannois concludes from his observations that: 1. The normal middle ear in animals acts like an aseptic cavity and contains no micro-organisms. 2. The liquid of catarrhal otitis media does or does not contain microbes, according to the period at which it is examined after the beginning. 3. The disappearance of the microbes is sometimes probably due to the bactericidal power of the mucous membrane and the mucus. 4. The bactericidal action explains why the secretion rarely becomes purulent, even after paracentesis and repeated catheterization.

MICROSCOPICAL SOCIETIES.

Sheffield Microscopical Society.

Friday, December 18th, Mr. G. T. W. Newsholme, Honorary Secretary, in the chair.—The President, Mr. A. H. Allen, lectured on "The Philosophy of the Microscope." He explained that he had chosen that subject because some people were at sea as to the optical principles involved in the use of the microscope. He reminded the gathering that we do not see light in the ordinary sense, but perceive it when it falls on something capable of reflecting it, and so reaches the eye. Another principle to which he called at-

tention, is that an object always appears to be in that direction in which the rays of light last reach the eye. It was, Mr. Allen said, a highly important principle, which was sometimes not so thoroughly borne in mind as it should be. Mr. Allen then described the laws of optics utilised in the construction of the microscope, illustrating his observations by numerous demonstrations carried out by means of a beam of light. He also explained the magnifying power of different object glasses and eye-pieces, and dealt in a chatty but interesting and instructive way with other details connected with the optical construction of the microscope.

Liverpool Microscopical Society.

"The Microscopic Study of Cotton and other Fibres," was the subject which Mr. F. H. Tate, F.C.S., discussed before the members of the Society recently. The paper dealt principally with cotton, and described the structure, mode of growth and development of the fibres. The different structures of the plant were exhibited by lantern illustrations and their several characteristics were explained. Micro-photography was relied upon to reveal the difference between healthy and diseased fibres. The fibres of other materials, as wool, silk, flax, etc., were similarly described and exhibited.

Quekett Microscopical Club.

The 346th ordinary meeting of this club was held on Friday, Nov. 20th, at 20, Hanover-square, Mr. J. G. Waller, president, in the chair. Mr. T. Rosseter, F.R.M.S., read a paper on a new *Cysticercus* and *Tænia*. The former infests the entomostracan, *Cypris fusca*, and the mature tapeworm develops in the common duck. Mr. Rosseter gave a most interesting account of his experiments in feeding the birds with the entomostraca, his frequent failures, and final success. The paper was illustrated by drawings of the various stages and details of structure, as well as by diagrams on the board. In moving a vote of thanks, the president remarked that Mr. Rosseter appeared to be the sole investigator of these parasites, so far

as birds were concerned, in this country; it was a wide field for those possessing the opportunity of study, and no doubt a great deal remained to be discovered. The vote was carried with applause. Mr. C. D. Soar exhibited a series of 41 beautiful drawings of Hydrachnidæ collected at the club's excursions during the past season, and gave a commentary on the life-history of the water mites in general. Many of these mites are most gorgeously colored and marked, and the series was much admired.

Quekett Microscopical Club.

The 347th ordinary meeting of this club was held on Friday, December 18, at 20, Hanover-square, Mr. J. G. Waller, F.S.A., President, in the chair. After the usual formal business, Messrs. Swift exhibited a double perforated stop for affixing cracker gelatine in experiments with color-ground illumination, to fit the diaphragm carrier of the Abbe or other similar condenser. Mr. W. Stokes read a paper "On Multiple Images in Mirrors," illustrated by diagrams. For the removal of these images Mr. Stokes advocated that microscope mirrors should be ground about 1° from parallelism when, on rotating the mirror in its cell, the images from the reflecting surfaces would superimpose in a certain position, and so merge into one. A paper "On a New Form of Sub-Stage Color Illuminator," by Mr. J. Rheinberg, was read for the author by Dr. Measures. It was shown that the color contrasts obtainable with this instrument were practically unlimited. A discussion followed. Mr. Nelson read a "Note on Some New Lenses," pointing out the fallacy of the term "aplanatic" as applied to the ordinary triplet magnifiers. Votes of thanks were given for these several communications, and the proceedings terminated.

It is stated that Mr. C. R. Bishop has authorised the trustees of the Bishop Museum to expend 750,000 dollars in building an aquarium and marine biological station at Honolulu for the study of marine life in the Pacific. Prof. W. T. Brigham is prepared to complete the plans.

MICROSCOPICAL NOTES.

Murder.—At a small town near Pittsburg, Alex. Killen was charged with robbing and murdering a woman who had owned a jewelry store. The culprit had broken a window and scraped the jewelry into a yellow satchel. In the haste some glass was included.

After Killen's arrest, such a satchel was found on his premises and some small pieces of glass found in it. At the trial, the District Attorney laid them on a sheet of paper and passed them to the jury. This was not satisfactory—a powerful microscope was brought in and each juror examined the bits of glass. A glass worker on the jury was satisfied that the bits were from window glass and not from a bottle which Killen said had been broken in the satchel. The other jurors accepted his suggestions and convicted Killen of Murder in the first degree—circumstantial evidence adduced by the use of a microscope.

Distribution of Fungi by Snails and Toads.—Voglino communicates a suggestive paper to the *Nuovo Giornale Bot. Ital.* (1895, 181), in which he demonstrates that certain fungi (*Agariciniae*) are distributed by snails and toads. An examination of the stomachs of the snails and toads. presence of the spores of various species of fungi which were seen to have begun their germination, and culture experiments with the excrements of various snails produced a large number of germinating spores of fungi. The same was observed on examining the stomachs of toads, in which the spores of *Russula* and *Lactarius* were specially abundant.

Honey Bee Secretes Formic Acid.—A fact which is interesting and perhaps new to many, is that the honey-bee after filling a cell with honey and covering it with the lid, adds to the honey a drop of formic acid. This is done by piercing the lid with the sting and depositing a drop of the poison from her sack. By numerous experiments it has been shown that formic acid added to honey or any sugar

solution prevents fermentation. Evidently the sting of the bee has a use besides that of defence.

The Management of the Journal of Nervous and Mental Diseases announces the following arrangement of the staff for 1897: Dr. Chas. L. Dana, Dr. F. X. Dercum, Dr. Philip Coombs Knapp, Dr. Chas. K. Mills, Dr. Jas. J. Putnaw, Dr. B. Sachs, Dr. M. Allen Starr, as editors. Dr. Philip Meirowitz, Dr. Wm. G. Spiller, as Associated Editors. Dr. Chas. Henry Brown, 25 West 45th St, New York, is Managing Editor.

Dr. George M. Sternberg, Surgeon General of the United States Army, has received the honorary degree of LL. D. from Brown University.

Dr. W. E. Castle has been appointed instructor in biology in Knox College, Galesbury, Ill.

RECENT PUBLICATIONS.

Mystic Masonry, or the Symbols of Freemasonry and the Greater Mysteries of Antiquity.—By J. D. Buck, M. D., Cincinnati: Robert Clarke Co. 265 pp. xiv pl. 12mo \$1.50.

This little book is a compendium of occult knowledge. The world at large will not comprehend it. Most people will not wish to do so. It will fall only into the hands of those who are somewhat curious regarding that which underlies and is greater than all religions and all fraternities. I am not a freemason but if tomorrow I had to part for life with two of the following three books: Shakespeare, The Bible, Buck's Mystic Masonry—I would keep the latter and let go the other two in spite of the mystic meaning which I now know to be concealed in the two former books. My reason is that I can remember much that is in the Bible, and not a little of Shakespeare but this book is new to me and contains the keys to all knowledge. I risk this assertion although I know that the declaration itself will mystify nearly all who read it.—C. W. S.

HAND OF MUMMY, 3,000 YEARS OLD, TAKEN
BY W. WATSON & SONS, WITH THEIR
RONTGEN RAY APPARATUS.

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Studies in Diatom Biology.

By K. M. CUNNINGHAM,
MOBILE, ALA.

During the month of November, 1895, I had an opportunity of securing a very interesting gathering of living diatoms under the following conditions. On one of my excursions I incidentally noted that the surface of a ditch used for transporting saw logs through a marshy flat, was covered with a thick and uniform layer of greenish scum, and that it was accidentally banked up at the point, by a boat paddle arresting its passage along the ditch. The winds were driving further supplies of scum to the obstruction across the ditch. A momentary inspection indicated that there was a very rich accumulation of diatoms. I secured a pint or so of the material for treatment and study. The chief or most numerous form occurring in the gathering was *Nitzschia scalaris*, which species, as is well known, is among the largest of the prism-like forms commonly encountered all over the globe, and is associated with fresh or brackish waters. By availing myself of the aid of this special form in its living state, I was enabled to prosecute some studies tending to give additional importance to the hypothesis that this diatom belongs biologically to the protozoa rather than to the plants. I shall indicate by what line of reasoning I venture to present this view to the attention of those who are interested in biological studies.

As a primary fact, we may assert that when a portion

of the material is gathered in its densest state, it is introduced into a suitable bottle, and the diatom contents are allowed to distribute themselves in the water. It is soon evident that many of the motile forms in the bottle are attaching themselves to the inside surface of the bottle and continue their motions incessantly in any chance direction. If now while having a bottle of this kind under inspection, as simple an apparatus as a common five cent lens, of a quarter inch focus will enable anyone to follow the motions of the large *Nitzschia scalaris* in its wanderings while in contact with the glass surface. This fact alone would be *prima facie* evidence of its having some organ adapting it to auto-locomotion, and that in a particularly striking manner. The same simple aid will also show that if one extremity of the prismatic body of the *Nitzschia* should become detached by shaking from contact with the side of the bottle, leaving but one end adherent, the end in contact still may have sufficient motive power therein to propel itself along the glass, and when a *Nitzschia* is thus moving around, it can be followed for hours, if the observer is so disposed.

This is the simple character of an initial study that might have been made by Leewenhoeck in his day, with credit to himself for whatever his observing mind might have noted in relation thereto. If now, however, the conditions under which we view the *Nitzschia* be modified, we may find a new series of phenomena that would have been totally overlooked in the experiment noted above. If during the study we transfer a dip of the diatom material covering some of the *Nitzschias* to a glass slip, and cover the same with a cover glass and view the living frustules with the aid of a 1-6 objective, then the peculiarities of locomotive and motile effects may be very readily observed. A close study will verify the fact that the *Nitzschia* has a distinct movement; not merely of progression or change of place in a rectilinear path, but

also that the entire epidermal coat may be actively engaged in gathering up any character of minute mineral or other debris along its path. Such particles as become attached, are independently moved from numerous centers of vital action. This is as if the epidermal surface at any given point had a retractile and contractile power, independent of any other given point of vital action along the frustular surface. The motile functions consist of the power of transporting small mineral particles such as sand grains and vegetal debris for appreciable distances along its edges or surface, and of rejecting them and substituting new particles. The particles may be jerked up at any point and carried indifferently in a positive or negative direction from the point of attachment, until these particles are replaced by new ones. It should strike any observer who may verify these phases of action that such phenomena point to a more complex cilia-like function than that which may be noted in the ciliary fringes of an oyster or clam. The latter cilia motion lashes and drives the particles in a general direction or current. The complicated system of moving particles can also be followed in its interminable variations as long as it may suit the convenience of the observer to change the specimen of *Nitzschia* under observation, on account of its relatively conspicuous size. *Nitzschia scalaris* is a very satisfactory species in which to study the character of its vital movements.

The internal frustular contents present an abundance of globular bodies of varying sizes which have a constant independent motion among themselves, that is, their juxtaposition is seen to be constantly changing when very carefully noted.

Nitzschia scalaris when viewed under a power of 500 diameters is longer than any other of the North American specimens of the bacillar forms, and therefore can be

observed with ease in verifying what is said herein in reference to its intricate motile powers.

In further studies of *Navicula nobilis* and *firma*, with the view to verifying the results obtained by a former contributor on the subject of the movements of diatoms, I made use of methyl-blue to differentiate the epidermal covering or mantle, by the following methods. From a rich gathering of living *Navicula nobilis*, *firma* and *Surirella biserriata*, and other forms, I transferred a drop to a slip, and observed them with a $\frac{1}{2}$ inch objective. By this means I was enabled to note that as many as twenty forms of *N. nobilis* and *firma* could be found in parallel contact at one and the same time, gliding back and forth in contact with each other, somewhat after the manner that colonies of *Bacillaria paradoxa* move at times. While having this special gathering under study in order to note the character of the epidermal envelope, it became relatively easy to note the amount of separation between two or more touching frustules of the surrounding transparent layers. Now, admitting that the external layer, if it exists at all, must have the character of an albuminous substance, such as the white of an egg, the substance ought to coagulate under a boiling temperature, and take on an altered or fixed state the same as the white of an egg does when boiled sufficiently. By shortly drying such a slide of living diatoms over a student's lamp flame, and completing the mount with thin balsam, we find that the epidermal covering has been changed to a practically impervious envelope. The thin balsam failed to penetrate many of the frustules during a period extending over months. The slide on examination periodically showed the frustules to be filled with air, and the shrunken or contracted threads of endoplasm still showed a strong greenish tint in the air filled spaces. On the contrary, it is well known that, in acid-treated diatoms of like character, there is almost an immediate ex-

pulsion of air from the frustule, and a substitution of the balsam in the air spaces. If these phases of study are accurately construed, we have a demonstration of the presence of enveloping substance on the exterior of the silicious frustules without resorting to staining tests for a like purpose.

Continuing this investigation, I made an attempt to differentiate the protoplasmic mantle with the aid of dyes in order to verify an experimental study recorded several years ago by C. Onderdonk and published in this journal. While I failed to duplicate what was stated therein, I found a wide range of interesting phenomena throwing light on the structure of the living diatoms. By placing a drop of water with numerous large *Naviculae* on a slip and covering it with a $\frac{1}{4}$ inch cover glass, and then placing in contact with the edge of the cover-glass, a minute grain of crystalline methyl-blue, the dye was speedily diffused from the edge of the glass and passed slowly across the fluid field. Then it was a very easy matter to steadily observe for protracted intervals the action of the dye, as its influence reached the living frustules. For example, the stain was absorbed by the frustule both inside as well as outside, some time before it was perceptible in the thin layer of liquid; and more markedly absorbed by the internal protoplasmic granules when the dyeing action became more evident. The evidence of a strong irritation on the part of the frustule is readily observed as it quickly loses the power of direct axial motion and swerves irregularly and spasmodically at alternate ends, unable to advance in its normal manner. It may even spin around in its own length, the power of controlling its normal traveling motion being in a manner paralyzed. At least this would be the probable interpretation, that any observer would identify with an irritating toxic substance acting on organisms having a determined or even conjectural nervous system

or a cellular structure to which poisons would be deadly in their effect. The process of encroachment of an aniline dye and its lethal results may be studied with equal interest in the smaller *Naviculæ* as in the larger. There is the same activity of irritation and arresting of locomotive power, and finally the death of the bioplasmic power, whether inside or outside of the frustule. For those who could find interest in the death struggles of vertebrate animals, as seen in the case of Spanish bull fights, or the asphyxiation of dogs during the canicula, might be found plenty of mental excitement in following the death throes of a diatom from start to finish, under the method of drowning in a weak aniline bath.

After having had sufficient familiarity with the phases leading up to the extinction of the life process of a series of living diatoms in the field of the microscope, it would perhaps be repugnant to the student to admit that he has been witnessing vital phenomena characteristic alone in its nature of plant or vegetable life. These forms have heretofore been deemed too insignificant to warrant for them a place among the Protozoans; the fundamental or simplest class of animal life which modern science has so far been able to trace.

By varying the dyeing tests with a substitution of common violet writing ink, I found features not observed during a lengthy study with methyl blue. When the violet stain reached the *Navicula*, I noted that what appeared to be a sort of vermicular festoon was formed from the mantle or surface of the frustule, and the vermicular shreds broke off and drifted away leaving some strands adhering to its sides and small villous tufts at each end of the frustule. This seemed to represent to me, what C. Onderdonk described as the mantle expanding or crinkling up like folds of cloth around the edges of the frustule. Apart from this, I found nothing that I could identify as that which he stated he had repeatedly verified in re-

gard to a differentiation of the mantle (ectoderm) enveloping the navicular forms by the use of methyl green. I had stained slides richly strewn with living diatoms upon which I made my observations and, on drying, the frustules were examined superficially with condensed light, and otherwise, only to find that the frustules gave off the metallic sheen of the dye, with the sculptural markings showing clearly; but the frustules were surrounded where in contact with the slip by a crystalline fringe of the methyl blue. They then simulated what might be construed as a sort of ciliary projection. This makes any deduction with reference to the mantle from this mode of study an unknown quantity. The essential points of C. Onderdonk's paper in relation to the mantle of the diatom, and a conjecture touching the seat of the vital function controlling its motile power, were adopted by Wolle in his *Diatomaceæ of North America*. Therein the marvelous phenomena of the diatom's power to handle and rush grains of sand, as often as its necessities may require it to do so, is entirely overlooked. I allude to the portion of the work upon the "Motion of Diatoms." This function of the diatom to gather up and transport mineral particles energetically, is one that can be readily verified with the aid of a 1-6 objective. No one need miss it. The study involves no difficulties.

W. A. Terry, an expert student of the living diatom, has frequently made allusions to the peculiarities of motion observed by himself, and from sources of supply that I have never had an opportunity to inspect, he has recently put on record the statement that some of the very large living *Amphiprora* observed by him might pass for vegetables but never for plants. As it was not his object to seek for data to establish the Protozoan nature of the Diatom his observations were not sufficiently critical to contribute to a formulary of expression adapted to animal biology. He had incidently noted that a vigorous

diatom had tractive power sufficient to push or pull a mass of obstructing matter equal to its own bulk or even greater. In connection with these remarks, it may be proper to relate that he has recently been cultivating or growing the living forms and kindly offered to mail to me a culture sample. But we feared that they would not arrive in good condition if sent.

Acting on a suggestion derived from H. L. Smith's work in relation to the action of alkali on the protoplasm of the living frustules in an experimental way, I found that if a mounted slide of living diatoms was immersed in strong white soap solution and set aside for about twenty-four hours, all the frustules containing the living endoplasm were burst asunder into numerous small fragments, and the greenish contents were driven out and distributed in rills over the slide. This also showed that sutural lines are weak points in the frustural box.

In an attempt to clean a considerable quantity of material, from which the studies of *Nitzschia scalaris* were made, by boiling in a pearline solution, the result showed that the recent species had become badly distorted by a partial solvent action, and a softening of the siliceous walls. This I had never previously noticed in acid treatment, but I had been aware of the necessity of using the alkalies cautiously in one stage of the cleaning process.

Those who undertake to solve for themselves the mysterious cause of motion in the diatoms, will be confronted with a species of phenomena of the most puzzling interest. If the living diatoms have been retained in the same bottle of water for a period extending over three days or more, the study will be complicated by the growth in the water of several kinds of spirillum, which are apt to colonize around the edges of all diatoms. When this is the case, it may so happen that when a large *Navicula* is being closely studied in the field in expecting to detect some characteristic of motion, the mind will suddenly be

attracted by lightning-like flashes of little specks with spiral and vibrating movements that dart from the ends and sides of the moving diatom. The illusion at first takes the form of an idea that the diatom is discharging nettle-like threads, and as quickly retracting them. Should the mind get caught under this spell once, it will be a material duration of time before the observer, fascinated by this illusory appearance, can dissociate his mind from the idea that what is seen is not a part of the vital function of the ectoderm of the diatom, and properly refer this action to the parasitic colonies of *Spirilla*, which seem to be living in symbiosis with their host the *Navicula*.

How to Make and Stock a Fresh-water Aquarium.

By REGINALD A. R. BENNETT, M. A. (OXON).

CONSTRUCTION OF THE TANK ITSELF.

When I saw the above announced as one of the subjects for the forth-coming competitions, I at once made up my mind to send in a series, and hope for the prize, for the "E. M." has been an old friend to me for many a long year, and I have all the back volumes from the very beginning arranged on my bookshelf. I cannot truly say that I took it in from the beginning, the first numbers having been presented to me some years afterwards; but, no doubt, I should have taken it when it first came out had it not been for the fact that the first numbers appeared during the same year that I myself burst upon this lower sphere, and at that time I was more interested in the maternal lacteal fluid than even in the advance of science. However, later volumes have been of invaluable service to me, and this is by no means the first time that I have written in "Ours," though not before in the form of an article.

As I see that there has been some discussion as to the

capabilities of the winners of these prizes, I will here state that I am writing this series from a personal experience with the matter, having myself practically kept fresh water (and I may add, also marine) aquaria for a good many years. The system and details of working laid down are, therefore, the result of practical knowledge.

I do not think it is necessary, in the pages of this journal, to enter very deeply into the science involved in the maintaining of an aquarium. Most of its readers are, doubtless, aware of the compensating action of the various animal and vegetable organisms, whereby the balance of life is kept up, and the fishes, etc., supply carbonic-acid gas which the plants, if in good health, utilize in the formation of their tissues, transforming it into pure oxygen, which being dissolved by the water, is taken up by the fishes and other animal organisms to be utilized in the aeration of their blood. From a consideration of these facts, it naturally follows that in our aquarium we must have a supply of healthy plants to manufacture the oxygen required, if the fishes are to be kept for a long time in a satisfactory state of prosperity. Given the suitable conditions, and it is perfectly possible to keep the aquarium for many years without changing the water, or moving animals or weeds. In practice I have done this myself, though if the aquarium keeper has a sufficiency of time on his hands, I think an occasional turning out and cleaning is more likely to produce a pleasing effect on the eye than leaving the tank to itself for the longest possible time. A great deal, however, depends upon the amount of water employed.

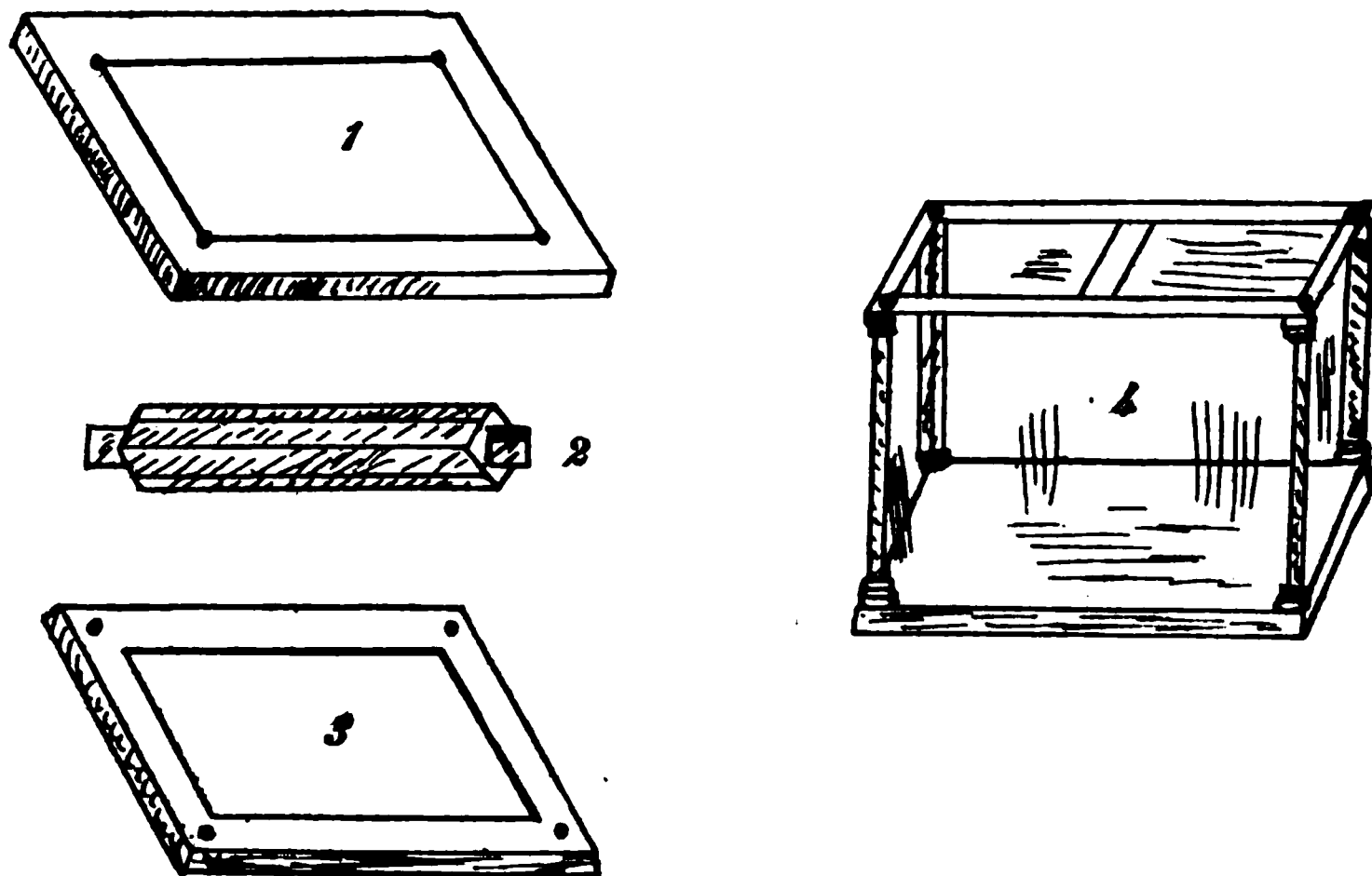
In setting up the aquarium, the first thing must necessarily be the manufacture of the tank itself. And here we are confronted by the question of the most suitable dimensions. I do not think, in the case of a fresh water-tank, the depth is a matter of very great importance,

as it certainly is in the case of a salt-water one. The amount of water it is to hold must, of course, settle its actual size; but, as a rule, it should be said that no tank should be deeper than it is wide, and its length should be about twice as long as its width. To descend to particulars: to hold 12 gallons the tank may be about 27 in. by 16 in. by 14 in. deep. One to hold up to 20 gallons will be about 36 in. long by 22 in. broad by 18 in. deep.

As to the actual structure of the tank, this, of course, depends very much upon the taste of the maker. Personally, I think the plainer the tank is (within limits) the better. It is the fishes and plants, etc., that are the objects of attraction—not a gorgeously ornamented tank. For this reason I look upon all ornamental “tops,” brass fringes, etc., round the edges, and carved images on the pillars, etc., as abominations. If the tank is to have a top it can be composed of two perfectly plain pieces of glass, each the width of the tank frame and rather less than half its length, thus leaving a little strip between them when they are placed in position, through which the air can get at the water. If the beetles, etc., show a disposition to get out the vacancy can afterwards be covered with a strip of perforated zinc. The glass is, of course, held in its place by fitting into a rabbet in the upper surface of the frame, in which it can lie.

The following will, I hope, be sufficiently explicit directions as to the actual manufacture of the tank for those who have never constructed anything similar before. The first thing to do is to make the bottom. For this I have tried plain wood, wood painted and varnished, and wood covered with glass and cement, and am decidedly of opinion that wood in any form is to be avoided. The best thing to use is a tolerably thick slab of *slate*, and taking my first dimensions of the tank as an example, I think for this the slab ought to measure about 29 in. by 18 in. by 2 in. thick. This allows of a width of an inch

all round, which is advisable, though not essential. In this slate, at a distance of about an inch from the edge all round, you have to make grooves with holes at the ends for the bottoms of the pillars, see Fig. 1. These holes should be about 1 in. in depth and the same in breadth; the grooves should be about $\frac{1}{4}$ in. broad and *at least* 1 in. deep. You now have to construct the pillars, which are made of hard birch wood—or mahogany will do—and are shaped as Fig. 2. The sides are, in my opinion, best square, but you can make them round if you prefer it. If square, the sides may measure 2 in. in breadth; if round, they ought to be at least $2\frac{1}{4}$ in. in diameter. The



ends are, of course, to be cut to a circle about 1 in. in diameter, or, better, shaped to accurately fit the holes made in the slate bottom. The part thus shaped will, therefore, be about 1 in. long, while the middle (square) part will be about 14 in. long. Down the middle of the pillars, on two sides, at right angles, are to be cut grooves about $\frac{1}{4}$ in. broad and *at least* $\frac{3}{4}$ in. in depth. Some may think my measurements unnecessarily large, but I have suffered so severely in bygone years from aquaria which leaked that I am quite resolved that if my measurements

are followed the English Mechanic tank shall, at any rate, be water-tight. To secure this desirable end, we have to fasten the pillars in their places with cement, and on this cement a great deal depends. It has to be elastic to a certain degree, so as to allow for changes of temperature and the consequent expansion and contraction of the glass and wood, it has to firmly resist the passage of the water, and it has to be one that will harden in a fairly short time, and that will not smell objectionable, as the living inhabitants of the tank are particularly susceptible to any foulness of the water caused by smells. The two best cements that I know of for the purpose, and which fairly fulfil the conditions required of them, are the following:—

Mix together one pint each of litharge, plaster of Paris, pure white sand, and two-thirds of a pint of freshly powered resin. These are thoroughly incorporated together by turning them over and rubbing them into one another with the hands, and the mixture is then made into paste with boiled oil and a little driers. It should be of sufficient consistency to dry pretty quickly, but not so stiff but that it will get into the holes and corners easily. If properly made this will not take long to dry; but you must leave the tank for a week at least, or more, before you attempt to stock it; and when you do so you must be quite sure, firstly, that the cement is really hard, and, secondly, that the smell has entirely departed. The second cement is made by melting in an iron ladle over a gas flame or lamp three-parts of pitch and one of gutta-percha. When they are thoroughly melted and incorporated together, apply liquid, and leave to set. This will not take so long as the other to dry, but it must be left till the smell has departed. It is impossible to lay too great stress on this matter. To use the tank too soon is not merely to court defeat, but to positively insure it. If the lead cement is used, it is advisable to cover it with

two or three coats of varnish, made by dissolving sealing-wax in methylated spirits of wine. When the pillars are fixed in their places, you can proceed to insert the glass. This is what is commonly called "32in." sheet glass, and is cut to exactly fit the grooves. The panes are firmly bedded in with the cement, and a light frame work is fitted on the top to hold all together. This framework is shown in Fig. 3. It is merely a frame about $1\frac{1}{2}$ in. in width and one-half inch in thickness. The top of each pillar, above the square part, is cut to this length and inserted in the holes at the corner, and small knobs are inserted at the corners to give the tank an ornamental appearance. If a glass top is wished for, the frame is cut with a rabbet about $\frac{1}{2}$ in. wide all round on its upper surface to receive the edges of the glass. The final appearance of the tank is shown in Fig. 4.

If the tank *has* to stand in a very sunny situation, I think it is decidedly advisable to provide some means or other of keeping out the superfluous light, as it acts most injuriously on the creature in it; and causes such a growth of *confervæ* on the sides that it is a continual nuisance to keep them clean. For this purpose I have always considered it best to have light shutters of thin wood constructed which will just go inside the frame formed by the bottom, top frame, and pillars, and outside the glass. This is done so easily that it requires no further description. I think this plan is desirable, because it allows of the complete closing of the sides of the tank in summer, when the weather is warm, and allows the shutters to be removed when it is desired to see any object close to the glass, or when the weather is cold during the winter. It is, therefore, much to be preferred to making the sides or ends permanently of slate.

In this series there is not space to describe further developments of the construction of the tank. It is also unnecessary, for any one, given the above details, can

easily construct any other form which his fancy may devise, or in combination with window conservatories, etc., by the use of a little brains. If the simple form of tank is used you will require a stand for it. This may have a top of its own, or the bottom of the tank may form the top. Anyhow, it is hardly necessary to say that it must, before all things, be firm and steady, as a collapse would be about as unpleasant a reverse of fortune as could befall the tyro aquarium keeper. It is preferable to use a table or stand with side bars between the legs about half way down.

When you are perfectly satisfied that the tank is quite dry, the cement hard, and that no smell is issuing from it, you can proceed to stock it, the method of which will be considered in the next chapter. But before placing anything in it, it should be most thoroughly cleansed by washing, and then rinsed with fresh water. After this, it must undergo a further process of purification by filling it with fresh water every few hours at first and letting it soak, then fresh water at intervals of a day, until the water is perfectly free from any smell, and especially from any prismatic scum on the surface, which is a sure indication of danger.—*English Mechanic*.

We learn from the French newspapers that M. Etienne will shortly introduce in the Chamber of Deputies a bill introducing the decimal subdivison of time.

Mr. C. G. Pringle has just returned from another botanical journey in Mexico, where, during the past season, he has secured about 20,000 herbarium specimens in the valley of Mexico and in Cuernavaca.

On account of his important work on Blood Test for cattle tuberculois, which has been published in many scientific papers at home and abroad, Dr. Ephraim Cutter, LL. D., has been invited to go to Africa to study the cattle Rinderpest, under the English government.

Surgical Sterilization and Sterilizers in Private Practice.

BY EDWARD BOECKMANN, M. D.,

ST. PAUL, MINN.

Last May I delivered an address in Buffalo, N. Y., before the Association of Military surgeons of the United States, on "Asepsis in Military Service." This address, printed in the transactions of that society, considers at length the principles of sterilization, and gives at the same time a number of practical points just as applicable in operations in private practice as in operations in military service, for which reason I take the liberty to refer you to that for details.

With regard to the mechanical and chemic phases of surgical sterilization I have not much to add to or take from what I said last year. Supported by further experience, I can this year more strongly than last recommend the 1 to 2 per cent solutions of lysol at 120 degrees F. for combined mechanical and chemic disinfection of the operator's hands and the patient's skin.

Lysol possesses the undeniable advantage of being at the same time antiseptic and aseptic; it is a happy combination of a powerful disinfectant and soap (saponified cresol). It has the dissolving and penetrating properties of an alkaline substance. I know of no agent which at the present time is better adapted and more reliable in the disinfection of the skin than lysol, with the possible exception of alcohol, which certainly, with good reasons, receives the support of the world. Heretofore we have viewed alcohol in the light of a purely mechanical agent in the disinfection of the skin; this can no longer be successfully maintained. Alcohol is certainly a potent solvent of a great number of substances, sparingly, however, of fats. Alcohol must be viewed as a strong antiseptic, possessing the same significance for the skin as for anatomic preparations, taking up its moisture, pene-

trating and hardening them; a decided advantage over ether and turpentine, which certainly dissolve fat much more readily, but which are much less hydrophile. In order to obtain the greatest possible antiseptic effects of alcohol it is obvious that the skin must be dried, and strong, preferably absolute alcohol used, and the skin energetically rubbed for some little time. Since experience has taught me that the germicidal principle in lysol acts as a powerful antiseptic in the above mentioned strength, and as a prolonged friction with absolute alcohol makes my skin uncomfortably hard and brittle, I reserve the alcohol for the field of operation only.

The last act in my sterilization of the skin consists in impregnating it with sterilized lanolin. By this procedure it is my intention to restore to the integument its fatty protective, which has been removed to the greatest possible extent by the preceding chemico-mechanical disinfection; at the same time I aim to cover up the remaining, inaccessible bacteria. Lanolin, which is rich in bacteria, is sterilized simply by heating the anhydrous article over the fire in an enameled vessel to about 350 degrees F., whereupon it is either run into collapsible tubes (sterilized in boiling water), or mixed with four to five parts of anhydrous ether, as soon as it has cooled below the boiling point of the latter, and then put into patent stoppered, sterilized glass bottles. Lanolin contains a great many impurities not soluble in ether, and which sink to the bottom as a voluminous, white sediment; only the clear, yellow solution is used.

Provided with lysol, absolute alcohol and ethereal solution of sterilized lanolin, we are enabled to disinfect the skin, the most dreaded bearer of infection, as safely I imagine, as is possible at this time; and with as few and simple agents as can be demanded in operations in private practice.

While I practically occupy the same standpoint with

regard to chemico-mechanical disinfection, I must take up the thread where I dropped it last year, as far as thermic disinfection is concerned. It is quite natural that surgeons who occupy themselves with operations in private practice, not only are interested in portable sterilizers, but also prefer such as are constructed for combined boiling in water and its steam. Inventive geniuses have also from time to time, at short intervals, endeavored to satisfy this popular demand, but they have all, as far as I know, up to the present committed the error of constructing their apparatus for under-steam, which streams through the sterilizing chamber from below upwards; that is, a stream, which neither expels the air, nor penetrates the articles to perfection, and which consequently results in deficient condensation, besides leaving the articles moist. All sterilizers for streaming steam must necessarily be constructed for over-steam; the reasons being fully given in my article previously referred to. Personally I am not particularly in favor of combination sterilizers even when scientifically constructed, chiefly because boiling and steaming are different processes requiring an unequal time, steaming at least three times as long as boiling, not to speak of the time required to dry the dressings after sterilization. This entails the practical disadvantage, that instruments, for which boiling is our method of choice, suffer unnecessarily in the prolonged boiling, but, as this can be avoided, as I will explain shortly, I have in deference to the apparent popular demand revived the idea of a combination apparatus, which I described in the *Medical Record* a couple of years ago, and it is my improvement upon that apparatus which I take the liberty to demonstrate upon this occasion.

My combination portable sterilizer consists, as you see, of four parts: 1, the boiling plan; 2, the hood; 3, the instrument tray, and 4, the steam chamber.

The boiling pan is made oval for the sake of the instruments; convenient dimensions being four to five inches high, eight inches wide and sixteen inches long. Around the upper border on its outside is constructed a groove half an inch deep. The center of the bottom is perforated by a small opening, into which is fastened a tube, which extends to the level of the upper border of the pan;

under the opening at the bottom is placed the iron plate, familiar from my other sterilizers.

The hood, which fits closely within the outer lip of the groove of the boiling pan described above, and whose height is adjusted to that of the steam chamber, above which it extends half an inch, has a sloping roof, whose extreme top is perforated and fitted with a short tube or chimney. The hood is supplied with handles, and can be fastened to the boiling pan by means of two hooks.

The instrument tray is made to fit accurately within the boiling pan, the corners are cut off to allow for the legs of the steam chamber, the bottom is of galvanized wire and the frame is provided with two handles.

The steam chamber is of the same form and dimensions as the boiling pan; the chamber extends downward in a

sloping bottom, whose lowest, perforated point is on a level with the upper border of the pan; into this opening is fastened a tube, which fits accurately outside that described in the boiling pan and which is of the same length; at the juncture of the steam chamber and its sloping bottom is placed a diaphragm of galvanized iron; between this and the opening beneath is a small square tin plate; the chamber rests upon four legs, is provided with



handles and a sloping cover, perforated at the top underneath a handle.

Directions for use.—The boiling pan is filled with a sufficient quantity of water, care being taken to fill the groove at the same time; the hood is adjusted, and the whole placed over any good fire. While the water is heating, the instruments are arranged on the tray, and the dressing, etc., (previously washed) in the steam chamber; needles, drainage tubes, ligating and suturing

materials are put separately in a small metal box (sterile catgut is brought along in hermetically sealed envelopes). When the water boils, the hood is removed, the steam chamber put in, whereupon the hood is replaced with a cork in the upper tube. The steam will now ascend between the hood and the steam chamber to the top; the cork at the top and the water in the groove and in the

pan acting as locks, the steam is forced to work its way through the opening in the cover of the steam chamber into this, through the articles contained, and out through the tube in the boiling pan. In the course of a quarter of an hour the sterilization is completed; the hood is removed, also the steam chamber; the instrument tray is now put in, the steam chamber is replaced, the hood likewise, *but without its cork*. For the preservation of the instruments a little soda or soap has been added (lysol serves the same purpose.) In the course of five minutes the instruments are surgically sterile; during this time the steam will escape continuously through the open tube

of the hood, both that delivered by the water and that contained in the steam chamber; simultaneously a draught of hot air will enter the chamber from below, and when this is removed, its contents are not only sterilized, but also dry. A combined sterilizer of the dimensions above mentioned can, without difficulty, be transported in a suitable wooden case, and as the preparation and sterilization of the necessaries is an easy matter, there is no possible excuse for resorting to mercantile antiseptic goods in operations in private practice. The surgeon who relies indiscriminately upon antiseptic wares, which he buys, is a dangerous man!

Articles adapted to sterilization by steam can safely

be transported to the place of operation in various ways, Bloch's method in double filtering paper being preferable; it is, however: always safer to sterilize on the spot, and, as only half an hour is required for the whole procedure, it is also practicable. In urgent emergency cases a surgeon ought never to be taken by surprise, and as time is valuable in such cases, he should always have on hand a supply of sterilized articles.

One more remark with regard to operations in private practice. I will most emphatically impress upon all surgeons, with the possible exception of those few who are masters both in surgical technique and in asepsis, to consider every wound at the end of an operation of some duration slightly infected, and therefore to combine their asepsis with a judical antiseptics. Thus I am in the habit of repeatedly dipping my hands during the operation in a weak, sterile solution of lysol ($\frac{1}{2}$ per cent or even less). The small amount of antiseptic which in this way is carried into the wound, I have yet failed to find objectionable, and I use lysol because it is at hand, and because it is alkaline like the fluids of the tissues. And when the operation is completed, I apply next to the wound an antiseptic dressing, not exactly the customary iodoform gauze, because its preparation requires extraordinary facilities, but antiseptic, and at the same time aseptic, hydrophile ointments. Anhydrous lanolin absorbs moisture greedily; it is first sterilized, mixed while cooling with 2 per cent lysol and run into tubes. A generous quantity is expressed over the wound, and over this the ordinary dressing is applied. Changing this dressing is unattended by the disturbance of the wound or the patient's comfort, as it does not stick like a dry dressing.

In the foregoing it has been my aim to dwell upon the most essential points in surgical sterilization and sterilizers in private practice, points which I could stamp with some degree of originality.—Journal Am. Med. Assoc.

The Preparation of Diphtheria Antitoxic Serum.

By H. K. MULFORD, PH. G.,

PHILADELPHIA, PA.

The discovery of diphtheria antitoxin was made by Behring as result of his primary and original investigation in connection with Kitasato upon tetanus antitoxin.

The method of preparation first proposed was the injection into suitable animals of cultures of the diphtheria bacilli in which the bacilli had been killed by heat. When the animal could withstand such injection, manifesting only a slight irritation or œdema at site of injection, or showing but feeble temperature reaction, highly attenuated living cultures were introduced in increasing amounts, a sufficient immunization or resistance being given by the primary injections to prevent fatal termination. The injection of living cultures, however, is greatly to be discouraged, since such injection and those of attenuated cultures containing dead bacilli are accompanied by great destruction of cellular tissue of the animal which is to furnish the antitoxin, its physical strength being lessened by such destructive processes.

The best method is as follows: As virulent a culture as possible of the *bacillus diphtheriæ* is obtained. It is grown upon Loeffler's solidified blood serum mixture and placed in an incubator at a temperature of 45 degrees C.

After a period of 24 hours the cultures are developed. From this a single culture or colony of the bacilli is transferred into small flasks of a 2 per cent peptone bouillon rendered decisively alkaline to litmus. These small flasks are placed in an incubator which is kept at a constant temperature of about 37 degrees C. for 24 to 48 hours, and afterward the contents are transferred with peptone bouillon into rounded flat flasks with a long neck (so that sterilized cotton may be pushed well into the tubulature) of a capacity of 500 ccm. These large flasks are placed

in the incubator and kept at a constant temperature of 37 degrees C. until the bacilli have become very numerous, and have secreted enormous amounts of active and powerful toxin in the bouillon.

When this has taken place a microscopical examination is made to see that bacilli other than the Klebs-Loeffler are not present, and the diphtheria toxin thus contaminated. If uncontaminated 1 per cent of trikresol is added to prevent contamination and to destroy the *bacillus diphtheriæ*. The bouillon, or, as we now term it, diphtheria toxin, is filtered through a modified Chamberland filter to separate from it the dead bodies of the diphtheria bacilli. No bacilli are therefore injected into the animals to be immunized, and they are not given diphtheria, but only the toxin secreted by the bacilli.

DETERMINING THE TOXICITY OF THE TOXIN.

The toxicity of the toxin is determined by its injection into guinea pigs. To be of the desired strength, 0.01 to 0.1 ccm. should produce death of the control animal in from 24 to 36 hours.

For the preparation of diphtheria antitoxin any animal may be selected, but horses are preferred, inasmuch as they are more easily operated upon, and because they furnish excellent serum in liberal amounts. Our experience as to the type of horses selected, particularly in the earlier observations, have been valuable, the majority being of unusually high quality, a number showing trace of fine breeding; such horses, however, are not suited for immunization. The finely bred horse being sensitive, frets at his inactivity (for no work is performed by the animal while being immunized, only a sufficient amount of exercise being given to maintain good health), neither does he take kindly to the injection of the toxin or the subsequent bleeding operations. The preference is given to large, compactly built animals, of dark color, 16 to 18

hands high, from 1,400 to 1,600 pounds weight, of quiet disposition, and possessing good health.

TESTING FOR GLANDERS AND TUBERCULOSIS.

Before the injecting with toxin, the malleine test for glanders and the tuberculin test for tuberculosis is applied, the results of such being clearly shown by the temperature. Animals responding to either of these tests must be discarded.

The primary injection of the toxin is 1 ccm. At equal periods of from six to eight days, constantly increasing amounts of the toxin are administered until in about ten weeks to three months as great quantities as 300 ccm. of this powerful toxin may be borne with tolerance.

When the injection of these larger amounts is accompanied with but little elevation of temperature, and but a slight oedema is manifested at site of injection, a trial bleeding is made, 20 ccm. of blood being taken from the jugular. If the tests for antitoxic value, as described later under the testing of antitoxin, are favorable, the horse is bled, the blood being collected in sterile bottles, and placed in a refrigerating room for a sufficient time (about 24 hours) until the fibrin coagulates, allowing the serum which contains the antitoxin to remain clear. This serum is drawn off by pipettes and preserved by the addition of 0.5 per cent trikresol.

The most important step now awaits the operator, the determination of the exact strength possessed by the antitoxin as expressed in immunizing units.

THE IMMUNIZING UNIT.

Immunizing units represent the strength of antitoxic serum that is required to save a guinea pig from ten times the absolute minimum fatal dose of the diphtheria toxin, and the strength of the antitoxin is designated by the number of immunizing units per ccm. of the serum.

For this purpose the minimum fatal dose of the toxin is

accurately determined by injections of various amounts of toxin into a number of guinea pigs, the smallest amount of toxin that invariably causes the death of the control animal in a reasonable time being regarded as the minimum fatal dose. It is usually calculated so much per 100 gm. body weight.

Every lot of antitoxin is carefully tested, and if the control animal shows evidences of œdema at site of injection, or diminution in body weight, the antitoxin is rejected.

A page from the laboratory minutes shows this determination of strength. Having found the minimum fatal dose here used to be 0.005 per gram weight of guinea pig, the control animals are given ten times this absolutely fatal dose of diphtheria toxin or poison, and if testing for 100 units per ccm., as appears from experiment on animal No. 1,080, 1-1000 ccm. antitoxin obtained from horse No. 109 H is given; if testing for 250 units per ccm., 1-2500 ccm. of antitoxin is given; if for 500 units, 1-5000 ccm. of antitoxin would be administered.

Tests for 500 units are shown on control animal 1,070 and for 350 units on control animal 1,076.

While this paper does not deal with the therapeutic value of diphtheria antitoxin, the absolute scientific value and correctness of these tests may be appreciated by these observations, and we prove the therapeutic application of the antitoxin by its neutralizing or protective value upon the control animals receiving ten times the amount of toxin that always kills. Unfortunately, we cannot thus arrive at the dose for therapeutic application since the human subject is much more susceptible to the poison, and we have no possible means of determining the amount of toxin secreted by the diphtheria bacilli in the patient suffering with diphtheria.

Appreciating, however, that the only effect of diphtheria antitoxin is in neutralizing the toxins of diphtheria, we know how necessary it is to make application of this

"healing serum" before the nerve centers become paralyzed, the heart and kidneys become diseased and the entire system invaded by the absorption of the fatal toxin.

THE PRESERVATION OF ANTITOXIN.

Diphtheria antitoxin is a most delicate substance, and its preparation can only be safely carried on in thoroughly equipped institutions where men of undoubted integrity of purpose and ability are in supervision.

While antitoxin is a delicate substance, yet, when a proper preservative in a sufficient amount is used, and it is hermetically sealed in sterile vials, it will preserve its strength and antitoxic value for at least six months; indeed, repeated experiments prove it retains its activity for a much longer period.

Chloroform, camphor, sodium salicylate, carbolic acid, and formaldehyde have been employed, but the preference is greatly in favor of trikresol and formaldehyde. Camphor seems to be particularly dangerous, since it possesses but a feeble preservative action, and its strong odor will prevent the detection of putrefactive processes should they be established; chloroform and sodium salicylate are unsuited on account of their active therapeutic effect.

Trikresol in a strength of but 0.5 per cent protects the serum absolutely; in fact, pathogenic bacteria do not develop with this percentage of trikresol; it is not a poison, as is carbolic acid, nor is it an irritant to the urethral tract. A disadvantage is that it produces a semi-fluorescent appearance in the serum, but the absence of cloudiness is shown by permitting the light to enter squarely through the vials containing the finished product.

STRENGTH OF SERUM.

Antitoxin is usually supplied in bottles containing varying quantities of serum, but of a certain number of antitoxic immunizing units. This is apt to lead to confusion,

and we would strongly recommend that a fixed standard of a definite number of immunizing units be secured in each ccm. of serum. While this involves extra labor, it prevents confusion on the part of the physician, and the end is well worthy of the increased labor. If serum is produced of a strength of 125 units per ccm., it may be mixed with an equal amount of serum containing 75 units per ccm.; the result is that each ccm. will contain 100 immunizing units, and if 500 units are desired to be administered, 5 ccm. will be understood as the requisite amount to be injected, etc.

HIGH POTENCY SERUM.

It is a matter of gratifying interest to Americans that serums of the highest antitoxic values have been prepared in our country. Serums are now produced of which each ccm. contains as much as 800 units, and we confidently believe that as much as 1,000 antitoxic units to the ccm. will be produced in the near future. This overcomes the chief objection that has been urged against the serum even by its warmest advocates. More prompt absorption will take place, insuring quicker results, besides the attendant dread caused by the large instruments necessary for the introduction of larger amounts of weaker serum will be avoided, as much as 2,000 units being administered in an ordinary two ccm. or 30 minim syringe.

DRIED SERUMS.

Dried serums are much less active than fluid or fresh ones. They are prepared by addition of aluminum or ammonium sulphate, with subsequent precipitation of the antitoxin by a 1 per cent soda solution or by inspissation. They have given fairly good results, but cause greater irritation than do the fluid serums, and not being freely soluble, cause annoyance in administration and give greater opportunities for contamination in their preparation and dilution for administration.

HOW ANTITOXIN ACTS.

We do not know what action takes place in the serum of the horse producing the antitoxin, nor do we know positively its action upon the organism of the control animal or the patient treated for diphtheria. The fact that the control animals always recover under the influence of antitoxin, while they always die with but one tenth the amount of toxin, and the reduction in mortality of patients ill with diphtheria under the influence of antitoxin, are, however, self-convincing. No reason can exist for its non-employment on this ground, since we do not know the nature of the changes from pepsin to peptones, albumen to albuminoids; the action of arsenic in anæmia, mercury in syphilis, and many of our therapeutic agents. They are used empirically because favorable results are secured.

The accepted theory of the action of antitoxin is that it renders the living cells of the organism tolerant to the toxin liberated by the diphtheria bacilli and by increasing this tolerance they are able to overcome these toxins.

That antitoxin exerts no chemical action on the toxin can be proved by mixing toxins and antitoxins, and maintaining the mixture at a temperature of 70 degrees C. for some time. At this temperature the antitoxin is destroyed, while the toxin remains but slightly disturbed in virulence.

Ewing and Billings have made numerous experiments as to the action of antitoxic serum upon the blood, and agree that: "In cases of diphtheria treated with antitoxin the diminution in the number of the red corpuscles is much less marked than in those cases treated without it. The leucocytes are apparently unaffected in number by the antitoxin, the hæmoglobin is also much less affected in the cases treated with antitoxin, thus confirming the statement as to the red corpuscles, while the leucocytes are stimulated in action, as evinced by taking more vivid color when stained with indigo solution."—*Am. Druggist*.

EDITORIAL.

The Cochineal Insect.—The cochineal insect is a native of Mexico, where it was raised by the Mexican Indians long before the country was discovered by the Spaniards. It is now cultivated in the West India Islands and in some of the Southern States but only in Mexico does it form an article of commerce.

The insect is raised on the cochineal tree, or nopal, which is a species of cactus. It grows freely from cuttings, and these are fit to receive insects after eighteen months. Into a nest formed of a thread-like substance or of cottony matter, a few females are placed about the first of October. The nests are fastened to the side of the tree facing the rising sun, and eggs are soon layed. As each female produces upwards of a thousand eggs, a large colony is formed. Six generations are produced in a single year.

On first leaving the egg the insects are quite lively and run about over the tree. They are so small as to require a magnifying glass to see them. They are flat, ovular, without wings and with short antennæ or horns. The females have a small, short, almost conical beak, placed between the first and second pair of feet, which contains a sucker. It is by means of this sucker that they draw forth the juices of leaves and tender stems.

When the insect has reached the perfect state, it is filled with a multitude of minute eggs. These she lays, then dies, her body becoming a covering for the eggs until they are hatched. When this is done the insects work their way out and commence feeding. After a short time their skins harden and serve as a cocoon. From this they pass into a chrysalis state, and soon after appear as the perfect insect.

The cochineal is collected about the first of December. The insects are removed from the trees with a knife or squirrel tail. They are then dried by heat or in the sun. When the cochineal arrives in the market it is in the form

of a small grain, concave on one side and convex on the other, having a little resemblance to the body of an insect. It colors purple naturally but when mixed with nitromuriatic acid gives a beautiful scarlet.

New deposits of Infusorial Earth found in Europe.—Some large deposits of kieselguhr (infusorial earth) have been discovered at Kissatib, near Achalzich, in the Caucasus. It occurs in strata which altogether are about 40ft. in thickness. Some of the strata are of a snowy white, while others are beautifully striped in various ways by layers of oxide of iron, etc., thus resembling marble. Efforts are being made to find a process for hardening this material, for its variety of beautiful designs combined with extreme lightness would make it a precious stone for architectural purposes. White kieselguhr is used for a variety of purposes, as in the manufacture of dynamite, colours (ultramarine), matches, for isolating purposes, etc. The Kissatib, kieselguhr is remarkable for its purify (3 percent of sand) and whiteness.

MICROSCOPICAL APPARATUS.

The Microscope in Pharmacy.—The pharmacist of to-day finds considerable use for the microscope; the pharmacist of to-morrow will find it an indispensable accessory in his business. Already a limited knowledge of the use of the instrument is required in the examination room, and as time passes the requirements in this direction are likely to be greatly extended. Accordingly, it seems desirable to point out that the microscopical examination of substances is simply an essential step in the complete visual examination of those substances. Everyone realises that the nearer, within certain limits, an object is brought to the normal eye, the larger it appears and the more distinctly its details are apparent. When brought within a distance of two or three inches, however, the image becomes blurred and indistinct, whilst an object held close to the eye cannot be seen at all, and simply obstructs light.

Now the use of a hand lens enables one to bring an object under examination much closer to the eye than is normally possible, for the outer surface of the lens represents that of the eye for the time being. As a result the object appears much larger, and more structural detail is revealed than when the object is viewed by the unassisted eye. Similarly, the compound microscope still further lessens the distance between the object and the eye, the surface of which is now represented by the front of the objective, and to speak of the image of an object as being enormously magnified under the microscope is simply another way of expressing the fact that the object has virtually been brought into such close proximity to the organ of sight as is normally impossible. Examination of an object by the aid of the microscope, therefore, must be regarded as a mere extension of the limits within which the normal human eye is capable of clearly distinguishing the details of objects. As spectacles help the partially blind to see, so the microscope enables those with perfect eyes to see more than is possible without such aid, and the natural conclusion is that pharmacists and others whose skill is partly dependent upon the accurate impressions they form of the appearance of objects, should be adepts in the use of an instrument that can so increase their natural powers.—Pharmaceutical Journal.

MICROSCOPICAL MANIPULATION.

Preservation of Microscopic Specimens.—Dr. Jores describes a method, which he has tested for a year and a half of preserving organs and tissues so that they retain the color they had when fresh. He finds that five to ten parts of a fifty per cent solution of formalin alone causes the organs to assume a tint which varies considerably from the natural color. But instead of using water to dilute the common formalin solution, he uses one part common salt, two parts of Magnesium sulphate, two parts sodium sulphate in one hundred parts of water. This preserves the color of the blood.

Further, material preserved in such a solution is better adapted for subsequent microscopic examination, since the protoplasm of the cell is less altered and the nucleus stained better and deeply.

The method he adopts is as follows:—The material must not be too long washed in water, and should be left in the formalin for a period depending on size and thickness. A kidney or spleen requires two days' immersion and the solution should be changed until it no longer gives a dirty brownish red color. Care must be taken to bring all portions of the object into contact with the solution, and the object must be given the color it is to retain permanently, since the formalin solution causes it to assume a consistency such that its shape cannot afterwards be modified. In the formalin solution the organs change color and become of a dirty bluish grey. On placing them in ninety-five per cent alcohol the normal color returns. Before permanently placing the organ in alcohol it must be washed in alcohol until the latter no longer becomes cloudy. The material must not be washed with water; it is left in alcohol until the normal color returns; if left longer the alcohol removes the color. For a kidney or spleen, twenty-four hours will be sufficient. The permanent preserving fluid is equal parts glycerine and water; the material floats at first but sinks later; the color is now at its best, after a little while the fluid becomes yellowish and wants renewal. Tissues so preserved have not undergone the slightest alteration in nine months.

The method is not applicable to other color than blood.—*Int. Med. Magazine.*

Infiltrating Dental and Osseous Tissues for Microscopical Work.—At a recent meeting of the Odontological Society of Great Britain Mr. Charters White gave the details of the method he adopts to demonstrate the presence of spaces in hard sections of dental and osseous tissues. The section to be treated must be ground moderately thin, to about 1-32 in., and then immersed in absolute alcohol for five minutes, and subsequently in ether for a similar period. It is next transferred to a thin solution of celloidin

(three grains of celloidin to half an ounce of equal parts of absolute alcohol and ether). This solution is colored red by the addition of fuchsine, the stain being added to the alcohol before the celloidin is dissolved. The specimen is allowed to remain in the solution for two or three days, after which it is removed and placed on paper to dry. The section is then ground to the desired tenuity and mounted on balsam. The advantages of the process are (1) the cavernous and tubular structures in dentine and bone are filled with a colored medium, which prevents the balsam from running into such spaces and so obliterating them; and (2) the section is rendered less brittle and can, therefore, be easily ground down without much fear of fracture.—English Mechanic.

BIOLOGICAL NOTES.

An international botanical garden is to be established at Palermo, under the direction of Prof. Borzi, of the University. It is hoped that the favorable position of the garden may attract foreign students.

It seems certain now that the late Dr. Alfred Nobel has made a munificent bequest to science. According to the terms of his will, so it is said, a fund is to be formed from all his realisable property, the yearly interest from which is to be divided into five equal portions, the first of which is to be allotted as a prize for the most important discovery in the domain of physics; the second for the principal chemical discovery or improvement; the third for the chief discovery in physiology or medicine; the fourth for the most distinguished literary contribution in the same field; and the fifth is to be allotted to whomsoever may have achieved the most or done the best to promote the cause of peace. All these prizes are open to the world. After deducting a few bequests to individuals, it is expected that the fund thus devised to the cause of progress will amount to the sum of nearly two millions sterling.—English Mechanic.

Mr. George J. Burch, of Oxford, England, has been experimenting upon plants with Rontgen photography. He finds that flower buds and seed vessels are especially favorable objects. He believes that if the photograph could be made upon a magnified scale the outline of every cell would be seen. The capsules of hyacinth and the flower buds of fuschia are reproduced in his account published in *Gardeners' Chronicle* III.

Numbers 11 and 12 of Lloyd's Photogravures of American Fungi have recently been distributed. They represent respectively *Lepiota morgani* Peck and *Sparassis herbstii* Peck, two interesting species. The first was photographed as it grew in the field, and makes an unusually attractive and characteristic picture.

BACTERIOLOGY.

Bacteriosis of Carnations.—Dr. J. C. Arthur and Prof. H. L. Bolley give an excellent account of one of the most serious difficulties the carnation grower has to encounter, namely, Bacteriosis which they ascribe to a new organism, *Bacterium dianthi*. The organism responsible for this disease is oval or elliptical in outline and does not occur in chains. It is motile and produces zoogloea. In gelatin it produces at first a smooth even growth along the track of the needle, having a pale cream color, later it assumes a marked appearance and the color is bright orange, being much deeper in acid cultures. It slowly liquefies gelatin. The zoogloea are formed as follows: "Certain individuals, without ceasing active multiplication, become non-motile, and at once begin to excrete a gelatinous envelope. This envelope offers considerable resistance to longitudinal extension, and the new cells as they form slip past one another, accumulating in an elongated mass, which increases faster in thickness than in length." If the nutrient material is not renewed, the zoogloea disintegrate in ten to fifteen days by liquefaction of the gelatinous envelope; this permits the bacteria to fall to the bottom of the fluid. They multiply very rapidly, a well marked constriction occurred

within seven minutes and in twenty minutes more there were two full grown bacteria formed from each original cell, although still attached to each other. At this rate of multiplication 280,000,000,000 would be formed in twenty four hours. They would occupy fully one inch of cubic space. This organism is an aerobe and makes comparatively rapid growth at 8-10 degrees C. The rate of division increases up to 34-36 degrees C, but above this point it is less rapid. Some growth was obtained at 45 degrees C. As to its parasitic nature, in its early stages the individual bacteria are imbedded in protoplasm, the chlorophyll grains become disorganized, the protoplasmic utricle is broken up and the contents of cell are disintegrated. This germ has the power of eroding the cell-wall and thus dissolves for itself a passage way, which may be brought about by an enzym and it is probable that the perforation in the cell-wall is quickly healed by growth and swelling of the same. They enter the host by means of stomata or accidental punctures. It readily attacks young and partly grown leaves. In addition to an account of the distribution of the disease and the varieties affected they treat the economic aspect. The paper is accompanied by two excellent colored plates and six other plates which show the character of the organisms. (Purdue University, Agrl. Exp. Sta. Bull., No. 59, Vol. VII, March, 1896.)

Microbes that Make Glucose.—Everyone knows the service-berry, that decorative shrub that retains its bright red berries even in the middle of winter. Now these berries were the subject of a sort of puzzle about half a century ago. In 1852 Pelouze, examining the juice of service berries that had been left for a long time at the bottom of a dish, discovered a perfectly crystallised substance, very sugary, and having all the properties of glucose. He saw nothing here that was not perfectly natural. We find sugar everywhere, or almost everywhere; there was therefore nothing astonishing in the discovery, and the new sugar was christened *sorbine* or *sorbose*. But now began the puzzle. When, a little later, other scientists de-

sired to prepare some sorbose directly, they could not get any. Byschl and Delffs could obtain it neither from the fresh nor the fermented juice. In short, the fantastic sorbose, born by chance in a laboratory retort, refused absolutely to make its appearance again. We know now why this was; the mystery has been brought to light by a chemist at the Museum—M. Bertrand. By crushing ripe service-berries and then exposing them to the open air M. Bertrand obtained first alcohol by ordinary fermentation, and soon a whitish layer covered the surface of the liquid; the alcohol disappeared in its turn, the layer grew mouldy, but in the remaining liquid it was proved that there was no trace of sorbose. He tried again and again, and one fine day on the layer of which we have spoken a fly alighted, a little red vinegar fly. Then all was changed. The membrane thickened, soon swarmed with larvæ, and in the liquid below it great quantities of sorbose appeared. This is what had taken place: the membrane was made thick and heavy by the thousands of microbes that had been brought by the little red fly, microbes whose oxidising influence had rapidly transformed the juice of the service-berries into sorbose. The experiment, after that, could be repeated at will. Thus recognised at length, the industrious microbes, whose length is less than a thousandth of a milli-metre (.025 of an inch) require no urging to manufacture in a few hours nearly a kilogram (2lb.) of the new kind of glucose.—Cosmos.

The experiments made with nitrogen in this country do not seem to be conclusive (see p. 561, Aug. 7 last). An important paper on the subject has appeared in a German bacteriological journal, giving experiments showing the capability possessed by *Bacillus radiciola* of growing on foreign culture media. It will be remembered that Dr. Nobbe isolated some twenty of these nitrogen-assimilating bacteria from the root nodules of various leguminous plants, and has endowed them with the collective title of "Nitragin." In the present experiments bacteria from the lucerne nodules were cultivated in pure media derived res-

pectively from infusions of lucerne and from white mustard, their cultivation being carried on through several generations. On the lucerne gelatine the bacteria flourished abundantly up to the last; on the mustard gelatine they gradually faded away. It was tried if these lucerne-nodule-bacteria could be induced to thrive on the mustard medium by gradual training, and in the course of six months that was accomplished.—English Mechanic.

MEDICAL MICROSCOPY.

Test for Typhoid Fever.—William Trelease, Recording Secretary of the Academy sent to *Science* the following account of the meeting January 4, 1897: Dr. Amand Ravold gave a microscopic demonstration of Widal's test for typhoid fever, demonstrating that after the disease has existed for four days or more the blood of typhoid patients, probably because of some contained anti-toxine, possesses the power of inhibiting the motion of typhoid bacilli from a pure culture introduced into it within a period of one hour or less, whereas in normal blood similar bacilli retain their power of locomotion for an indefinite length of time. It was stated that typhoid blood possesses this property even after having been dried for a period of four weeks or more, so that a few drops obtained from a person suspected of having the disease may be sent to suitable places for applying the test, thus rendering comparatively easy the early diagnosis of a disease which in its early stages presents many clinical difficulties.

PERSONALS.

We learn through the newspapers that on December 26, the remains of Prof. Louis Pasteur, the eminent bacteriologist, who died September 28, 1895, were removed from the Cathedral of Norte-Dame to the Institute, where they were received by a gathering of distinguished men, including Premier Meline, MM. Rambaud and Brisson and sev-

eral well known men from Great Britian. President Faure and Gen. Billot, the minister of war, were represented at the ceremony. Speeches were made at the crypt of the institute by M. Rambaud, M. Bodin, president of the municipal council of Paris, Dr. Evans, Dr. Rice Duckworth and others.

Dr. John B. Hamilton has resigned from the Marine Hospital service.

Dr. Geo. H. Rohe, Secretary of the Rush Monument Committee reports October 31, that since the last report in April he has received the small sum of \$159.00 making a total of \$3,886.39.

Dr. Hugo de Vries has been appointed director of the botanical gardens at Amsterdam in the place of Dr. Oudemans.

Dr. J. de Winter, assistant in the Zoological garden at Antwerp, has been made director of the Zoological garden at Giseh, near Cairo.

It is announced that Pfeiffer has found an efficacious and reliable antitoxin for typhoid fever.

Dr. W. M. L. Coplin, of Philadelphia, has been appointed bacteriologist to the Pennsylvania State Board of Health, and Dr. Richard Slee of Swiftwater, Dr. Nelson F. Davis, of Bucknell University, and Dr. Robert L. Pitfield, of Germantown, assistant bacteriologists.

The widow of Baron Maurice Hirsch, of Vienna, has resolved to present two millions of francs (£80,000) to the Pasteur Institute, as a memorial of her husband.—English Mechanic.

MICROSCOPICAL NOTES.

Mrs. J. E. Reeves, 201 McCallie Ave., Chattanooga, Tenn., has 35 or 40 dozens of "unnamed" slides to sell. They are the last work of her late husband, Dr. J. E. Reeves. She has also as many or more of "named" slides.

A good microscope for sale cheap. Pacific Medical Journal Office, 603 Sutter St., San Francisco, Cal.

Barbados.—The official papers of Barbados spell the word as above and not as we have heretofore given it in the articles of certain contributors—Barbadoes.

A small crystal of Thymol will preserve urinary sediments.

There is now once more a University of Paris. The inauguration has been celebrated in the new building of the Sorbonne.

The twelfth International Congress of Medicine will take place from August 19th to 26th, 1897, at Moscow.

It is reported that a lady has presented the French Academy with 800,000 francs, the interest of which is to go to any one who will discover a cure for consumption.

The annual budget in Paris for the Assistance Publique amounts to the large sum of \$8,000,000; of this the medical and surgical personnel receives \$200,000.

A report comes from the Medico-Surgical Society of Antwerp of the discovery of an antitoxin for pneumonia by Dr. Mennes, of Louvain. The microbe is stated to be extremely small, of a shape approaching an oval. At present successful experiments have been confined to animals.—English Mechanic.

Ink for Writing on Glass.—Shellac 20 parts, alcohol 150 parts, borax 35 parts, water 250 parts. Water soluble dye, sufficient to color. Dissolve the shellac in the alcohol, the borax in the water and pour the shellac solution slowly into that of the borax. Then add the coloring matter, previously dissolved in a little water.

Dr. Sidney Yankauer of New York County, exhibited at the thirteenth annual meeting of the New York State Medical Association, 1896, a simple and inexpensive microtome which he devised. With the model shown he said he had cut sections in celloidin a thousandth of an inch thick, and in paraffin sections only one five-thousandth of an inch thick



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HISTOLOGY OF THE STRIPED MUSCLE.

THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

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No. 3

The Striped Muscle Fibre: A few Points in its Comparative Histology.

By LOUISE TAYLER,

PATTERSON, N. J.

(With Frontispiece.)

The striped muscle fibre has been the centre of interest for many years. This may be seen from all books touching upon the subject found in any biological library. Perhaps the most work has been done toward determining the ultimate nature of the cross striping, and in other regards it has had less attention. In the few notes here offered, some points of a different nature are presented; points not so generally presented in those discussions.

The muscle tissue of the following animals has been examined in regard to these points:

- | | | |
|---------------------|-----------|--------|
| 1 The Elasmobranch, | 2 Frog, | |
| 3 Turtle, | 4 Snake, | |
| 5 Pigeon, | 6 Rabbit, | 7 Cat. |

Before taking up this discussion a general review of striped muscle may be of use. The mass of skeletal muscular substance is collected into distinct organs, muscles, the most of which are attached by means of fibrous

DESCRIPTION OF THE FRONTISPIECE.

1. Transection of striped muscle; frog.
2. Transection of striped muscle; rabbit.
3. Larger section of striped muscle fibre; frog.
4. Same as Fig. 1, enlarged.
5. Transection of striped muscle fibre; turtle.
6. Transection of striped muscle fibre; pigeon.
7. Same as in Fig. 2, enlarged.
8. Transection of striped muscle; 13-day chick embryo.
9. Transection of striped muscle; 20-day chick embryo.

connective tissue to some firm part upon which they may act (Fig. 1, 2). The whole muscle is enclosed within a connective tissue sheath. Each muscle is divided into bundles called fascicles, which are also surrounded by sheaths of connective tissue. The fascicles again are divided into individual fibres, which are separated by very similar connective tissue sheaths from each other.

These fibres, the structural elements, are elongated transversely striated cells, or rather fibres, composed of two distinct parts, the sarcolemma and the sarcous substance. The sarcolemma is a thin transparent and elastic sheath. The sarcous substance is a semi-fluid with the appearance of alternate dark and light bands and also of longitudinal striations. This substance is the essential part of a muscle fibre. It is not yet certain whether the covering or sarcolemma fits over this sarcous substance like a glove finger or whether it is connected structurally with it.

Very complex theories have been proposed concerning the ultimate structure of the muscle fibre; the simplest and that most in harmony with the probable structure of other cells is as follows: The protoplasm of the fibre is composed of a network of threads. This network, instead of being arranged irregularly as in most cells, is arranged regularly in longitudinal and transverse threads (Fig. 3). These threads cross each other at right angles and at points of crossing, enlargements like beads are formed. The enlargements optically run together across the fibre, making the dark bands, the thin parts between appearing to form light bands. Owing to the fact that the longitudinal threads are stronger than the transverse threads, there is a tendency for the fibres to break up into longitudinal elements known as fibriles.

In a transverse section each muscle fibre shows a division into a number of small polygonal areas, known as Cohnheim's areas. These are composed of bundles of

fibrils and bear a similar relation to the fibres that the fascicles do to the muscle.

Each fibre, moreover, contains nuclei. They are oval bodies, the long axis usually placed parallel with the long axis of the fibre (Fig. 3). The position of nuclei varies greatly in the different animal forms and for this reason special stress is laid upon it in this discussion. The points to be emphasized are, the position and number of nuclei imbedded in the sarcous substance and the relative sizes of the different fibres. The animals have been chosen from widely varying classes to give a fair representation of all types. They are taken up in order, according to their classification in the animal kingdom.

The fish representative is an elasmobranch, the dogfish. Its striped muscle fibre is long and cylindrical as is usual. At its ends it tapers suddenly, the striated condition is lost and only the connective tissue covering stretches out into muscle attachment. The fibres vary in width but an average diameter of twenty fibres, as shown in section, is 74 microns. The nuclei are imbedded in the sarcous substance and only rarely is one found by the edge, making but eleven per cent of the whole number in this position.

The frog is the amphibian representative (Fig. 4). The different fibres vary greatly in width, those nearer the outer edge of a muscle section appearing much smaller. This may be due to the fact that the fibres terminate on the outer edge in the sheath of muscle. The average diameter of twenty fibres as shown in section is 66 microns. The only measurements found mentioned are those given by Gage (Reference Handbook of Medical Science, Vol. V. p): the approximate width is 56 microns for amphibians. 87 per cent of the nuclei are imbedded in the sarcous substance. A transection of a fibre shows from one to six nuclei. The frog is quite a

tiated amphibian and for that reason these points differ in the more generalized forms.

Turtle representing the reptiles, differs from the (Fig. 5). The muscle fibres appear in transection more angular and the diameter is smaller. An average of twenty measures 55 microns, in the turtle. About 10 per cent of the nuclei are imbedded in the sarcous substance.

This shows an advance in one line, over the frog. Pigeon is considered next (Fig. 6). This animal, though not belonging to the highest class of mammals belonging among warm blooded animals. Naturally differences are expected between this and the cold blooded forms. The first difference noted is that the fascicles are more distinct. The average diameter of twenty fibres is 24 microns. The nuclei are found to a great extent at the periphery and only 3 per cent are imbedded in the sarcous substance.

Coming to the mammals, one finds still more differences (Fig. 7). The fascicles in the rabbit are much more distinct than has yet been found and are surrounded by more connective tissue. In section, the individual fibres are far more angular, making the form more prismatic than cylindrical,—an average of 20 diameters 25 microns, less than one-half the size of the frog. The rabbit fibre has only 10 per cent of its nuclei imbedded in the sarcous substance. This leaves by far the greater part at the edge, projecting out, even pushing out the connective tissue. The cat's muscle is very like that of the rabbit though there is more connective tissue between the fascicles and also between the fibres themselves. This is due to the greater activity and strength in the rabbit. The domestic rabbit, necessitates a large blood supply and firm binding of parts together.

An average of 20 fibres in diameter measures 25 microns, and none of its nuclei are imbedded in the sarcous substance.

There is a wide difference between these last fibres examined and the first; the results are expressed in the following summary:--

	Average Diameter.	Average per cent of nuclei imbedded in sarcous substances.
Dog-fish,	74 microns	89 per cent
Frog,	66 microns	87 per cent
Turtle,	55 microns	77 per cent
Pigeon,	24 microns	3 per cent
Rabbit,	25 microns	$\frac{1}{2}$ per cent
Cat,	24 microns	0 per cent

This table shows a gradual change in the muscle fibre from the more general to the specialized animals; the size of the fibres not only gradually grows smaller and generally more angular but they are more surrounded by connective tissue. The nuclei gradually approach the edge and in the highest forms are even pushing out, making projections on the surface of the fibres.

There is a large gap, however, between the cold blooded and warm blooded animals, giving two distinct groups, both in diameter of fibre and per cent of nuclei imbedded in the sarcous substance.

FACTS FROM EMBRYOLOGICAL FORMS.—There is a suggestion that perhaps some intermediate forms could be found—unless variation is dependent on physiological conditions wholly—in developing muscle in embryos. By a study into some developing tissues of the chick embryos of 13, 16, 18 and 20 days, the series of changes observed is both interesting and suggestive. The series begins with irregular ill-defined cells (Fig. 8), which in the next stage (16 days) shows clearly defined fibres with centrally placed nuclei. The next stage, in transection shows in a cell, more than one nucleus generally centrally placed and the last stage examined (Fig. 9) shows most of the nuclei at the edge of the sarcous substance as in the adult pigeon. The cells, however, are very much smaller than in the adult, the 20 examined

measuring only an average of 10 microns at the 20-day stage. This would be expected from the physiological conditions of inactivity.

FACTS FROM ADULT FORMS.—As the skeletal muscle is looked upon as the most highly developed, consequently an examination of striped muscle which is not voluntary may also throw some light upon the subject under consideration. Of these forms, the cardiac is most suggestive; the fibre in it is much shorter and contains only one centrally placed nucleus. This then is less specialized than the striped muscle fibre of the frog for one centrally placed nucleus is a characteristic of the plain muscle fibre. The question arises, is there any striped muscle, otherwise placed, which may show some difference? The muscle in the esophagus offers a basis for comparison. Sections both longitudinal and transverse have been examined from the various parts of the tubes of some of the animals already noted. The esophagus of the frog has only plain muscle. The rabbit's esophagus has plain muscle fibre at the stomach end, but this gradually changes toward the other end where the striped muscle fibre is like the skeletal muscle in the position of its nuclei. The average per cent of nuclei imbedded in the sarcous substance is $1\frac{1}{2}$ per cent, but the variation from the middle of tube to the mouth end is from 4 per cent to 0 per cent. Nothing like cardiac muscle, in the gradual change, could be observed, though some writers state that fibres become short toward the middle of the esophagus. The cat's esophagus has also plain muscle at the stomach end and gradually changes to striped muscle toward the other end. It has an average of 20 per cent of nuclei imbedded in the sarcous substance. This large number may be due to the fact that the sections, from which the observations were made, were of tissue quite far down this tube. Taking it, however, as correct on the whole, the position of the

nuclei in the striped muscle fibres of the cat's esophagus may be considered less specialized than that of the rabbit's esophagus. It may be regarded as an interesting fact that in the rabbit, the nuclei are quite centrally situated when not at the edge where as in the cat, those in the sarcous substance appear only just off the edge of the sarcolemma.

The embryonic chick esophagus affords interesting gradations too. The earlier stages show distinct cells, each with a central nucleus. They appear in transection as very like plain muscle fibres. In an older embryo, the fibres are more angular, the striated condition distinct and the nuclei both centrally and marginally situated as in the pigeon, with the greater per cent at the margin.

Thus we find a series of adult structures in various animals showing certain marked differences. An embryological series may be made showing variation of a developing structure in one animal that corresponds in general to the series of adult forms. Also intermediate forms may be found in adult animals by considering some part (esophagus) not so strongly voluntary in action.

The table given above, shows that the muscle fibres become more specialized, the higher we go in the animal kingdom. In position of nuclei, the large gap between the cold blooded and warm blooded animals is bridged over by the developing tissues of the chick embryo. It is known that striped muscle develops from cells similar to plain muscle fibres. The facts given above in regard to the striped muscle of the esophagus and chick embryonic tissues illustrate how specialized skeletal muscles develop, from plain muscles and that ancestral forms may be found in the skeletal muscles of the less specialized animals.

[The above work was done at the Wesley College laboratory under the kindly direction of Miss E. J. Claypole, to whom the writer gratefully acknowledges indebtedness.]

Tests For Microscope Objectives.†

By EDWARD M. NELSON,

LONDON, ENGLAND.

Power, practically, has very little to do with the resolution of diatomic striæ with oblique light—eyepiecing easily remedies any defect on that score; quality of objective has also (contrary to the usually received opinion) little to do with it; a bad objective may be a strong striæ resolver. The only other factors left, then, are those of aperture, skillful manipulation, and keenness of perception. Given the requisite aperture, skillful manipulation and keenness of perception (assuming that keenness of vision is present) will come with intelligent practice.

We must in the first place, recognise that some of the diatoms above enumerated are by no means constant in the fineness of their structure; consequently, the resolution of their striæ by oblique illumination is no criterion of the aperture of an objective, neither is it of its quality.

With a $\frac{3}{4}$ axial cone, *P. angulatum*, dry on cover, is a good test for the highest quality lenses from $\frac{1}{2}$ in. upwards. Note, the slide should be what is called a “spread slide.” As a rule, it is better to avoid “selected diatoms,” especially when mounted dry on cover.

We should also remember that the test lies more in the quality of the image than in the strength of the resolution. Therefore, the quality of an image yielded by a coarse diatom, well within the grip of the objective,

†In reply to the following questions: (1) for what particular powers are the following diatoms generally recognised as suitable tests: *Surirella gemma*, *Pleurosigma attenuatum*, *Pleurosigma angulatum*, *Navicula lyra*, *Grammatophora marina*, *Stauroneis phoenicenteron*, *Triceratium favus*? (2) In which of the following media are the above diatoms resolved most easily with dry objectives of suitable power and aperture: Styrax, balsam, mono-brom naphthalin, mono-brom balsam, or mounted dry? (3) What is approximately the lowest magnifying power under which, with an objective capable of dividing *Pleurosigma angulatum*, the dots may be distinctly discerned by an eye of average power of vision? (4) Which variety of *Coscinodiscus* most easily shows the secondary markings?

affords a better test than a faint striation just glimpsed with a lens barely possessing the necessary aperture to resolve it.

N. lyra.—Two nights ago, I saw one valve in balsam beautifully dotted with a 1 in. on a dark ground. Another valve, however, was so fine, that it required a wide-angled $\frac{1}{2}$ in. to do it.

One of the best diatoms to work on with the higher powers is the large *N. rhomboides*, found in "Sozodont" tooth-powder (discovered in this material by G. Mainland, F.R.M.S.); it is very constant in fineness, the trans. striæ being 60,000 per inch. Zeiss apochromatic $\frac{1}{2}$ in. crosses it.

The best test for low-power lenses, say, from $1\frac{1}{2}$ to $\frac{1}{2}$ or 4-10 of .6 N.A. is a balsam-mounted diatom with dark ground illumination by Abbe's achromatic condenser and central stop. The stop should be just of a sufficient size to give a perfectly dark ground, and no larger. This test consists in the freedom from scattered light about the diatom. A coarse *N. lyra* does very well; the clear structureless parts of the diatom should be free from scattered light from the neighbouring parts that have structure. Of course, the lenses must be accurately adjusted by the alteration of tube-length. For the higher powers a bright field should be used from a $\frac{1}{2}$ axial cone, and the finer forms of *Lyra*, or *P. formosum*, or the larger *N. rhomboides* are suitable. These may be mounted in balsam, or better, styrax; or, better still, in quinidine. Quinidine is the best medium, but for some reason or other it is very difficult to work with. I have one of the first slides prepared in this medium which is still excellent; but most of the others in my possession have gone bad. The fact that one of the early slides is perfect shows that mounts in this medium are possible. Why they cannot be multiplied is a mystery I am unable to fathom.

A spread slide of *P. angulatum* dry on cover is an excellent test. The minimum power required to see it in dots with a $\frac{3}{4}$ axial cone is about 220 diams. I have myself glimpsed it with slightly less, but then the image was very difficult. An old cheap student's $\frac{1}{2}$ N.A. .72 showed it with a magnification of 250. Probably some of the modern cheap semi-apochromats would do it with less. The Zeiss apochromatic $\frac{1}{2}$ N. A. .65 dots it easily with a large axial cone. It has even been seen with this fine lens with the 8 compensating eyepiece. P. and L. old achromatic 4-10 N.A. .64, power, 290, also does it. All modern students' $\frac{1}{4}$ and $\frac{1}{2}$, semi-apochromatic or otherwise, should do it also.

The golden rule for the resolving power of any objective with a $\frac{3}{4}$ axial cone of illumination is that they should show a fineness of structure equal to 70,000 multiplied by their N.A. Thus—

TABLE I.

N.A.	Fineness of Structure Resolved.
0.1	7,000
0.2	14,000
0.3	21,000
0.4	28,000
0.5	35,000
0.6	42,000
0.7	49,000
0.8	56,000
0.9	63,000
1.0	70,000
1.1	77,000
1.2	84,000
1.3	91,000
1.4	98,000
1.5	105,000

Table II. agrees very well with Table I. It must be remembered that some of the lenses which apparently do not come up to the rule gave a very strong resolution of the numbers opposite to them; they therefore would probably have resolved a trifle more, but there was not at hand a slightly finer-marked diatom to test them on.

The following table shows what has actually been achieved on diatoms in balsam with a $\frac{3}{4}$ axial cone. A comparison of this table with the former will be instructive:—

TABLE II.

Objective.	N. A.	Resolved.
Apochromatic 1in.....	·32	22,000
Achromatic 4-10.....	·64	40,000
Apochromatic $\frac{1}{2}$	·66	46,000
Semi-apochromatic $\frac{1}{4}$	·71	53,500
Achromatic $\frac{1}{4}$	·79	53,000
Semi-apochromatic 1-7.....	·86	60,000
Achromatic 1-5.....	·88	60,000
Apochromatic $\frac{1}{4}$	·95	65,000
Semi-apochromatic 1-12.....	1·26	90,000
Apochromatic $\frac{1}{4}$	1·43	94,000

I do not know which of the Coscinodisci has the coarsest secondaries. *Asteromphalus* is fairly coarse. Some of the *Triceratia* have very coarse secondaries—*Thumii* may be one of them.

With regard to mounting media, there has been too much made of high refractive index, and too little of spectrum irrationality. Piperine has a high index, but its irrationality spoils it.

The order of merit may be taken as follows:—

1. Quinidine, by far the best; unstable.
2. Styrax, very good and permanent.
3. Balsam, permanent.
4. Monobromide, not good.

Prof. Smith's, Dr. Meale's and Father Thompson's media are uncertain, difficult, and very dangerous to work with.

In conclusion, let me urge workers to procure a Gifford's F line screen for use at the back of the condenser; they are quite inexpensive. They greatly improve the definition, and make cheap semi-apochromats almost equal to the most expensive apochromats; they even improve apochromats, and they increase the resolving power.—English Mechanic.

Notes on Comparative Histology of Blood and Muscle.

BY EDITH J. CLAYPOLE,

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There is great difficulty in basing general histology on the various books and discussions of human histology. Even if any mammal other than man is made the object of study there is difficulty since many of the tissues of the cat and rabbit for instance, vary widely from the same tissues in man, while among the still lower forms still greater differences exist. Compound tissues vary largely and even many elementary ones are markedly distinct.

The animals chosen for these few notes were the rabbit, cat, pigeon, turtle, snake, frog, ambleptoma, cryptobranchus, necturus; slightly amia, a ganoid fish and protopterus, a dipnoan fish; only two tissues were examined thoroughly, blood and striped muscle. Others are partly worked out, but not fully enough for discussion.

BLOOD.—This tissue has been very largely worked on owing to its medico-legal importance, interest being centred in the size and number of the red corpuscles. These cells of all animals fall into two natural groups, those with, and those without nuclei. All mammals possess non-nucleated corpuscles; vertebrates, birds, reptiles, amphibians and fishes possess nucleated corpuscles.

From various sources I have collected or made measurements of as many forms in these classes as possible with the following results placed in tabular form.

These figures are suggestive. Variation occurs from 6 to 75 microns, a gradual decrease in size from generalized to specialized forms, both in different members in the same class (salamanders, frogs, cæcilians) and in the different classes (amphibians, fishes, reptiles, birds, and mammals). At each end of the table are specialized forms, not equally so, but both far from primitive, modern

fishes and birds and mammals. The amphibia lie between a class acknowledged to contain widely varying forms, some highly specialized, others exceedingly generalized. The variation in size of red corpuscle corresponds with this range in form. They are small in cæcilians, 18·2x15 very large in amphiuma, a salamander.

OVAL CELLS.				L.	B.
FISHES	L.	B.		microns	microns
<i>Teleost</i>			Amphiuma	75.	45.
Carp	15.	9.	REPTILES		
<i>Ganoid</i>			Turtle	10.	6.
Sturgeon	13.	10.	Snake	10.7	12.9
Amia	11.6	8.6	Lizard	{ 16.	10.
<i>Elasmos</i>				{ 13.	10.
Ray	28.5		Alligator	20.	7.
Shark	22.6		BIRDS		
<i>Dipnoan</i>			Fowl	12.	7.
Lepidosiran	41.	29.	Pigeon	12.	7.
AMPHIBIANS			MAMMALS		
Scaly	18.2	15.	Camel	8.	4.
Frog	23.2	16.5			
Toad	24.	16.			
Megalobatrachus	47.	33.			
Cryptobranchus	48.7	29.2			
Necturus	58.4	31.1			
Proteus	58.	35.			
Siren	59.	30.			

CIRCULAR CELLS.

	microns
Man	7.5
Mammals	6.5
Lampery	12.6
Cyclostomes	11.3

There is another striking change in this series. The normal absence of the nucleus from the mammalian red corpuscles and the presence of it in all other red corpuscles is well-known. A brief consideration of the function of the red cell helps in explaining this fact. It is no longer a typical cell, it is very highly specialized for one purpose, to take up oxygen, the more oxygen it can carry the more efficient it is. Hæmoglobine is the essential oxygen carrier in the corpuscle, by crowding out the nucleus more of this substance can be present, hence the corpuscle becomes more efficient. A series can be made showing the gradual loss in different animal forms, large in amphibians, it is reduced to small size in birds and in mammals is gone entirely. Decrease in size follows the same law. Exchange is far more rapid between small masses than between large ones, and small cell elements

result in mammals, shown in blood corpuscles as well as elsewhere.

MUSCLE.—The subject of striped muscle has been much worked on, but some of the minor points are the ones of most significance in this present discussion. It is well known that in mammals the nuclei of the fibres lie just under the sarcolemma or limiting membrane of the fibre. In the frog they lie scattered through the sarcous substance. The size and shape of fibre, number, shape and size of nuclei and also the structure of the sarcous substance as apparent from longisections and transections are of significance. The following animals were used: lamprey, amia, frog, amblystoma, cryptobranchus, necturus, snake, turtle, pigeon, and cat. The results are shown in the following table.

	Size Microns	No. of Nuclei	Location of Nuclei	Coarse or Fine in section
Lamprey	10	1-2	Inside	Medium
Amia	18.9	1-2	"	Fine
Protopterus	35	1-2	Edge	"
Frog	45	2-5	Inside	"
Amblystoma	42.3	2-3	"	Coarse
Cryptobranchus	78.6	2-3	"	"
Necturus	88.5	2-3	"	"
Turtle	54	2-1	"	"
Snake	(97.8	3-5	"	{ Very Fine
	(89.7	25-35	"	
Bird	20.7	2-3	Edge	Coarse
Mammal	21.1	1-2	"	Fine

Warm blooded and cold blooded animals are sharply cut away from each other with one exception the dipnoan *Protopterus*, in which, strange to say, the nuclei are at the edge as in birds and mammals. On the whole there is about the same number of nuclei, with one exception to be discussed later. The terms coarse and fine are used to describe the appearance of the fibres in transection. This difference in character is probably due to the varying size of the constituent fibrils in different animals. If they are large, a coarse effect results; if small, a fine effect. The same fact explains the difference in length-

wise view, some show very markedly longitudinal striations, the coarse ones. In the snake some peculiar conditions were found. Two kinds of fibre shown in transsection, one typical coarse grained with 3-4 nuclei, another very dense with 25-35 nuclei in it. Examination of longisection shows these to belong to one fibre, one structure passing abruptly into the other. The nuclei are small round bodies instead of oval, the only suggestion as present is that it may be some especial form of ending.

The general conclusions reached are that in nuclei as in blood, generalized forms of animals have large elements, specialized small, in spite of greater muscular power in latter. The difference in location of nuclei may be explained by the mechanical disadvantage of a number of non-contractile masses among the contractile material. They interfere with the straight pull, hence in most differentiated, active animals (birds and mammals) the nuclei are "pushed to the wall," making the contractile force all available for locomotion instead of being somewhat dissipated by oblique pulls.

This general law is deduced, — the more generalized the animal the larger the tissue elements, the more highly specialized the smaller are the elements. Exceptions occur of course, but they only serve to prove the rule. Only two tissues have been discussed here, but an interesting field of work is opened by this treatment of these component parts of animals by the same method as have long been applied to the study of comparative anatomy.

DISCUSSION.

BEFORE THE AMERICAN MICROSCOPICAL SOCIETY.

Professor S. H. Gage—This subject that has been gone over often has had a little new life put into it. Miss Claypole has considered it from the physiological instead of from the mechanical standpoint. There are at the present day two great schools of physiologists, those that believe physiology is refined mechanics, and those that believe it is something more than ordinary mechanics.

This paper has another beautiful feature about it that shows to the older ones as well as to the younger that there is not any subject exhausted yet. Every increase in knowledge makes an old subject a new one, and this subject has been made alive and interesting.

Mrs. S. P. Gage—It has been very pleasing to notice in this study that the evolution of tissues is coming to be considered of equal interest with the evolution of the grosser structures.

Professor E. W. Claypole—We have the evolution of these tissues and of these animals to consider. Unfortunately, from a geological standpoint, we can not get tissues, except in a few cases, to replace what these ancient creatures possessed in the way of tissues. If we trust the embryologist, there must have been some change going on in the course of the evolution of these animals on the earth, and it occurred to me that that is partly connected with the change that took place when land-life first began. As long as the reptiles were confined to the sea the animals possessed the advantage of breathing through their skins, but land-life deprived the animals of the power of breathing through the skin, and that along with the increased burden of breathing through the lungs. The change took place somewhere in reptile life; that change was accompanied by the necessity for greatly increased oxidation of blood in the lungs.

We then have to consider such a question as this: Why should the camel alone among the mammalia possess these oval blood corpuscles? That is a question not yet answered by the paleontologists. The lamprey may be regarded as a highly specialized parasitic creature, because it sucks the blood of other creatures. The lampreys can be carried back to the Devonian era, and if they possessed blood discs almost spherical, then these must be prerequisites of very ancient vertebrates. If the lamprey goes back to the Devonian age, it counts among the very early ones.

Dr. V. A. Moore—No tissue is more largely affected in the diseases of animals than the blood, although much is known. Still little is known about its variations, changes and susceptibility to not only the solids but those now going under the name of toxin and antitoxin. This paper opens up the field of the variability of structure of the blood in the same individual regarding atmosphere and temperature, food, and so on. I do not know of an exhaustive treatise on the blood of a single healthy animal, and it is on the healthy condition that pathologists base their status. It is important we should study the condition of the blood in a single specimen.

Disinfection of Mails from Plague Districts.—The Pennsylvania State board suggests to the Post-master General, in view of the fact that the plague is a germ disease, the importance of taking the necessary steps to insure the disinfection of all mails coming from districts in which the disease may prevail.

On Soundings from the Pacific Ocean.

BY ARTHUR M. EDWARDS, M. D.

NEWARK, N. J.

In February, 1877, there were submitted to me by the California Academy of Science certain soundings brought home by Commander George E. Belknap of the U. S. S. "Tuscarora" which were taken in the Pacific Ocean with an understanding that I should make a microscopical examination of them and submit a report thereon. Being called away to the Eastern coast by illness, I was unable to do so until lately. I then made a partial report because I had already made certain discoveries that the soundings brought to light. A fuller report has waited the obtaining of further samples. The discoveries made and herein suggested, bear on the soundings from the Atlantic Ocean, as well as the Neocene rocks of California and also of the Eastern coast of North America and elsewhere. The report made was only temporary, (First) because of the imperfect state the specimens were in, being dry and old; and (Secondly) because they are so incomplete, there being many in the list which I will detail further, and which at this time I do not have, and (Thirdly) because this branch of science is in a very unsatisfactory state. Hence a report at the present time must be to a certain extent unsatisfactory. But their examination does not interfere with the discovery which I have now to report and which may seem important.

The specimens were one hundred and eighty-four in number and will be described in detail hereafter.

Lately I came across a thin volume, which is called: "Synopsis of the cruise of the U. S. S. Tuscarora from the date of her commission to her arrival in San Francisco, Cal., Sept. 2, 1874. Compiled by Henry Cummings, San Francisco, 1874." This gave me a list of all the soundings made. They are from Cape Flattery to San

Francisco, from Cape Flattery to Atcha (Aleutian Islands), from San Francisco to San Diego, Cal., from San Diego, Cal., to Honolulu, H. I. to Port Lloyd, Bonin Islands, from Bonin Islands to Yokohama, Japan, and from Yokohama, Japan to the Island of Tanaga (Aleutian Group).

One of the soundings of which unfortunately the label was destroyed, but which from other evidence seems to be from somewhere near the Sandwich Islands is of considerable interest, for it appears to be correlative, if it is not of the same date, with what was taken by H. M. S. "Challenger" in the South Pacific. But the Tuscarora sounding is from the North Pacific. It also is the same as was secured by Sir J. D. Hooker in the Antarctic region and is described in the transactions of the British Association for the Advancement of Science. Oxford meeting, 1847.

The forms of Bacillariaceæ (Diatomaceæ) were in the Tuscarora specimens as follows:

- Actinocyclus ehrenbergii*, J. R.
- Actinoptychus undulatus*, C. G. E.
- Arachnoidiscus ehrenbergii*, J. W. B.
- Asteromphalus*
- Biddulphia aurita*, L.
- Chætoceras gastridium*, C. G. E.
- monice*, A. G.
- Coscinodiscus excentricus*, C. G. E.
- patera*, C.
- radiatus*, C. G. E.
- umbonatus*, C.
- Cyclotella astræa*, F. T. K.
- Denticula elegans*, F. T. K.
- palea*, N.
- Fragilaria pacifica*, A. G.
- Grammatophora tropica*, F. T. K.
- Isthmia*
- Podosira hormoides*, M.
- Rhizosolenia*
- Synedra jeffreysii*, G. D.
- Thalassicolia fraunfeldii*, (G.) C.

A specimen I have from H. M. S. Challenger sound-

ings, which is labelled as from 1950 fathoms, contains in it:

- Actinocyclus ehrenbergii*, J. R.
- Actinoptychus undulatus*, G. G. E.
- Arachnoidiscus ehrenbergii*, J. W. B.
- Biddulphia aurita*, L.
- Chætoceros gastridium*, C. G. E.
- monicae*, A. G.
- Coccinodiscus patera*, C.
- umboniatum*, C.
- Denticula palcea*, N.
- Fragilaria pacifica*, S. G.
- Grammatophora tropica*, F. T. K.
- Podosira hormoides*, M.
- Synedra jeffreysii*, G. D.

The same forms are to be found in the Neocene of California whenever it has been examined, from Crescent City in Del Norte county on the north to a spot about forty miles south of the southern limit in Southern California, that is to say into Mexico. They are the same in the infusorial earth of the Atlantic Coast of North America, and likewise in South America when it has been detected at Payta and Mejillones in Peru. In North America it is known as Miocene territory and is seen at Atlantic City in New Jersey, at Richmond in Virginia, at various points in Maryland, as at Nottingham, and at Tampa Bay in Florida. It is likewise known at Oran in Africa, at Moron in Spain, at Mors in Denmark, at Catani-setta in Sicily, at Simbirsk in Russia, and at Senz Peter in Hungary. Besides, it is known at Netansi in Japan and Oamaru in New Zealand.

And what does this bring us to? We have to compare the forms of Bacillaria, Rhizopoda and Foramenifera of these different localities and we find them essentially the same in all. We have also to compare the forms of Bacillaria, Rhizopoda and Foramenifera of the soundings in the Pacific and Atlantic oceans and we find them the same. Can we not say that the strata are the same in composition *chemically* and the same in organic forms?

I think they are. And can we separate the Neocene from the recent soundings in any respect? I do not think so. It has been more than hinted at the likelihood of the Neocene of California being but recent from comparing them by lithographic reasons, and I think they can also be likened from palæontologic reasons likewise. We can not distinguish Neocene Bacillaria, Rhizopoda or Foramenifera from recent which are living now. Although the strata in New Zealand have been placed in the Cretaceous, and at Simbirsk in the lower Eocene, we must expect to see them bearing like forms to the recent, and which live more on the bottom of the ocean and are in every inlet along the coast.

Practical Methods of Demonstrating Tubercle Bacilli.

By W. N. SHERMAN M. D.,

MERCED, CAL.

Read before the San Joaquin Valley Medical Society.

When we consider the rapid progress of medical science, we must realize the vast field of literature with which the general practitioner should familiarize himself, in order to keep posted. With such conditions confronting us, we must economize our time and adopt methods, that are shortest and quickest, in enabling us to reach conclusions and to obtain results. For this reason the tendency of the science of bacteriology is to teach methods by which we can most quickly reach results, and thus make a quick and sure diagnosis of contagious and other diseases. In such diseases as cholera and diphtheria, a skillful bacteriologist may, within 24 hours, establish a positive diagnosis, by means of the microscope. In cases of tubercular disease of the lungs, a positive diagnosis may be established in fifteen minutes, when the most careful and skillful physical examination may have failed to reveal the slightest lesion.

The various methods of examining sputa for the tubercle bacillus would only seem to confuse the beginner, unless he had ample time at his disposal. Numerous modifications of the original Koch-Erhlich method have been recommended and adopted, the constant aim being to simplify and shorten the *technique* without detracting from its reliability. Biedert has recently recommended the following method for demonstrating the bacilli when they are scant in number. A teaspoonful of sputum and two teaspoonfuls of water are boiled with 15 drops of solution of caustic soda, then four teaspoonfuls of water are added and the whole again boiled until it forms a homogenous fluid. It is allowed to stand for two days (not longer) in a conical glass, when the bacilli and elastic fibers form the sediment, which is to be stained by the Ziehl-Neilson process. When one is not accustomed to examine for the bacillus tuberculosis, for the purpose of controlling the degree of staining, he should, at the same time, stain some sputum that is known to contain the bacillus, or else keep a few test slides on hand.

Another method of preparing the sputum, is the method of Dahlen: the sputum, contained in a vessel, is heated (not boiled) in boiling water, thus precipitating the solid substance and the bacilli, which can be examined at once. The digestive method is a substitute for the Biedert method, and is superior in many respects. The sputum is introduced into a test tube, and the digestive fluid added, which is 1 per cent of hydrochloric acid containing pepsin. The test tube is then placed in an incubator or water bath, at a temperature of 98.6° F. for an hour, when it is removed, shaken and allowed to sediment. Before spreading on the cover glass the fluid must be rendered alkaline by adding a drop or more of caustic potash. The staining is done in the usual way.

It is best for the beginner to choose a simple and easy

method of staining, and to stick to the one method, as by constant practice he becomes more skilled. It is always best to prepare a number of slides from each specimen, as some of them may fail to show the bacilli.

The simplest and quickest method of staining is that of Gabbet, and it requires but two solution, which may be preserved for months. The cover glass, prepared and dried in the usual way, is placed for two minutes in a solution of 1 part of fuchsin in 100 parts of a 5 per cent solution of carbolic acid, and 10 parts of absolute alcohol. It is best to warm this solution. The cover glass is next removed from this solution, rinsed in water, and placed for one minute in a solution of 2 parts of methylin blue to 100 parts of a 25 per cent solution of sulphuric acid. It is again rinsed in water, then in alcohol; and dried and mounted in balsam. The preparations made by this method are very beautiful and permanent.

The method which I employ is that of Pittion and Roux. With this, more time is required, and more skill in manipulation; but when skillfully used, the bacilli are larger and more distinct than by any other procedure. Three solutions are used, and all should be fresh except the first. Sol. *a* is 10 parts of fuchsin in 100 parts of absolute alcohol. Sol. *b*, 3 parts liq. ammon. in 100 parts distilled water. Sol. *c*, alcohol 50, water 30, nitric acid 20, aniline green to saturation; dissolve the color in alcohol, then add the water and next the acid.

To use, take of *a* 1 part and of *b* 10 parts, heat until vapor appears, and float cover glass in usual way for about two minutes, then rinse in distilled water, and place in solution *c* until the red color disappears, then wash and mount. It takes some experience to know just how much to decolorize.

The tubercle bacilli are distinctly recognized by their red staining. With a good specimen and careful staining by this method the bacilli appear as large under a

dry 1-5 objective as under a 1-10 immersion objective by staining processes. Their presence in the sputum is a sure indication of tuberculosis of the lungs or larynx. Quite a close approximation of the severity of the disease may be made by the number of bacilli, but more closely by the quantity of the spores. Bacilli are often discovered when the physical signs are still indistinct or altogether wanting. Absence of the bacilli at a single examination is without value.

These slides [specimens exhibited] are stained by the two methods last mentioned, and are from the sputum of a patient under treatment with Edison's aseptolin since February 22, 1896. The expectoration has continually decreased in quantity, but there seems to be little effect, if any, upon the form and number of the bacilli.—*Occidental Medical Times*.

EDITORIAL.

Le Naturaliste Canadien.—The scientific publication of that name, founded by l'Abbe Provencher and edited at present by l'Abbe V. A. Huard of Chicoutimi, Canada, enters with the January number upon its 24th year. We wish success to one of the oldest pioneers of learning in a country where natural science has comparatively few votaries.

Diatomaceous Earth Free.—Mr. K. M. Cunningham, having in the month, June, 1896, discovered a new Fossil Marine Diatomaceous deposit near Suggsville, Clarke Co., Ala., which deposit has characters closely approaching the deposits of Richmond, Va., and Monterey, Pacific Coast, and further having in the month of December past, secured some fifty pounds of the material for distribution to anyone, makes a free offer to our subscribers who may enclose to us postage at the rate of one cent per ounce. The material contains twenty-five or more genera of Diatoms,

many species of Foramenifera, sponge spicules, Radiolarians, Coccoliths of the chalk, stellate spicules crystals of selenite, and is a rich clay that can be studied with ease by experts or amateurs in microscopy.

Pritchard's Infusoria.—We have for sale a copy of the latest edition of that beautiful work with colored plates. Price \$30. Also Smith's British Diatomaceæ, two volumes, uncut. Price \$30. These works are very scarce and can only be got, as in this case, when a microscopist from Europe finishes using them. We trust that some scientific society or public library will be desirous to possess them, since they are very rare volumes.

The Pasteur Gardens.—The municipality of Mexico has given the name of Pasteur to the gardens situated in front of the National School of medicine in that city.

Monumental.—A conflict more windy than sanguinary arose between Surgeon General Sternberg, of the United States Army, and Surgeon General A. L. Gihon, of the United States Marine Hospital Service, retired! General Sternberg made a motion at the American Public Health Association that the secretary be requested to accept contributions for a monument to Pasteur, and he suggested that each member contribute a dollar for the cause. This brought General Gihon to his feet with a jump. For years he had been trying to raise funds for a monument to Benjamin Rush, whom he considered to have been the greatest American physician, and he moved as an amendment to Dr. Sternberg's motion that each member that contributed \$1 to the Pasteur monument should be called on for \$10 for a monument to Benjamin Rush. The amendment was declared out of order, and Dr. Gihon submitted a motion similar to that of Dr. Sternberg, with Rush's name instead of Pasteur's. All of the resolutions were referred to the Executive Committee.

Professor Nocard of Alfort, near Paris, has received the award of the Lacaze prize, \$2000 in value, for his researches in animal tuberculosis.

PRACTICAL HINTS.

BY R. H. WARD, M. D.

TROY, N. Y.

A Simple Expedient in Focusing.—I have just noticed that one intended suggestion, which is perhaps curious enough to be worth noticing separately, was inadvertently omitted in putting in order my article on "Focusing Upward" in a former No. of *THE MICROSCOPE*. In the method there recommended as the only safe one for the inexperienced, and the best one for all, of looking horizontally through, between the objective and the slide, until the lens is near the slide without touching it, there is often difficulty, in certain arrangements of the microscope and the light, requiring light to be thrown through by a hand mirror, or a bright background to be presented by holding up, in suitable position and light, a piece of white paper or card. In such cases it is often very easy to trace the descent of the lens by looking obliquely downward and viewing the reflection of its lower face from the surface of the slide. This method, which is familiarly and safely used by the expert, is however a critical one, and excessively dangerous to the rash and inexperienced, especially if not thoroughly familiar with optical principles and appearances. The working distance of the objective is not shown directly, as in the former case, but obliquely and it may easily be misjudged; and the end of the mounting of the objective is not always what or where it seems. There are of course, moreover, four reflections in dry mounts, from the top and bottom each of the cover-glass and the slide, though two of these are naturally obliterated by "medium" in other mounts, and the deeper reflections are not usually distinct enough to mislead, even if noticed at all. This method, however, should not be used by beginners, nor ever with objectives or slides that are not the property of the manipulator; as a slight misunderstanding would cause a fatal accident to slide or objective, if not to both.

Preservation of Library Mucilage.—The recent discussions, in THE MICROSCOPE and elsewhere, of methods for preparing permanent mucilages and pastes for the library or study table, seem to leave little need of addition, except to give a caution that salicylic and carbolic acids, lately recommended as preservatives by a very high chemical authority, are wholly unsatisfactory. Antiseptics of this class soon turn the whole stock to a red color which is said to be due to action upon the metal of the brushes commonly used in the mucilage bottle.

For those who prefer an off-hand method wholly free from the delay and trouble of making up a special formula the camphor method is probably the best. You simply drop a lump of camphor, about as large as a bean or half of a chestnut, more or less, into the bottle of mucilage, and then use and replenish the supply just as if the lump was not there. It does no harm there, but keeps the solution so saturated with camphor that it cannot mould or ferment. When the supply of mucilage becomes low, you drop in some gum Arabic powder, and pour in and stir in some cold filtered water, and it is ready to use in two or three minutes. When you happen to notice, after some months, that the piece of camphor is very small, you drop in another piece. And that is all. I have used this method a great many years, and have never seen it fail.

For Moistening Envelopes, postage stamps, and gummed pasters generally, I have found, after trying also various fancy arrangements that have been introduced, nothing so practicable for general library use (excluding perhaps some business uses where the employment is almost constant) as a second mucilage bottle and its brush, supplied with filtered water. A mere trace of gelatin or gum added to the water makes it more manageable, by giving a little body to it; though this is by no means necessary, and though it greatly hastens the deterioration of the stock by keeping. A lump of camphor floating on the liquid, as a preservative, will, in either case, keep it in a neat condition much longer than without. It ought to be no longer necessary to say a word in favor of some such expedient in-

stead of the filthy fashion of licking pasters; to say nothing of the certainty of irritation and discomfort, and the evident danger of serious disease, from the sawing of harsh edges of dry paper across the tender surface of the tongue.

MICROSCOPICAL MANIPULATION.

Stable Picro-Carmine Solution.—A satisfactory picro-carmine, yielding a solution that has been proved to keep good for five years, may be made as follows:

Pure carmine is dissolved in a mixture of ammonia water 1 part by volume and water 4 parts, care being taken to keep the carmine in slight excess. After standing for two days filter the solution, and expose it until a precipitate begins to form, protecting it from dust meanwhile. Again filter, and add concentrated solution of picric acid (? to excess), then agitate and set aside for 24 hours, when a third filtration must be followed by the addition of 1 part of chloral hydrate to every 1,000 parts of solution. At the end of a week filter for the last time, and immediately bottle off in small, glass-stoppered vials.

Stain for Tubercle Bacilli.—Hardin W. Bright, M. D., Professor of Histology, Pathology and Bacteriology in the Tennessee Medical College, sends us the following: Place three drams water in test tube, add five drops alboline. Shake thoroughly, then filter. Of above filtrate 100 parts Sat. aqueous sol. Fuchsin ten parts, 80 per cent alcohol ten parts. The above solution will keep better than if aniline oil be used.

Stain ten minutes in above solution, decolorize, in 30 per cent Nitric acid, wash in alcohol, stain three minutes in aq. Sat. Sol. Methylene Blue, wash in water, dry and mount in Canada balsam. The above stain is an improvement over Ehrlich's. I find it unnecessary to warm solution. I have a specimen stained by this method which I have kept for over one year and the bacilli are as distinct as when first stained. The envelope can be clearly differentiated from the stained protoplasmic contents of the cell.

Revival of an Old Histological Method for Rapid Diagnosis.—Dr. A. A. Kanthack and Mr. T. S. Pigg found, of all rapid methods of hardening tissue, that of immersing small blocks in boiling water for three or four minutes or in the case of delicate tissue one minute, was the most rapid. The tissue could then be at once cut on the freezing microtome, and the section stained well with logwood or other dyes; or it could be preserved in alcohol or Muller's fluid, or treated by the paraffin method. For rapid diagnosis in the case of surgical operations, it was particularly valuable. —British Medical Journal.

Stains for Vegetable Tissues.—Dr. E. Vinassa has investigated the value of aniline colors for staining vegetable tissues, and divides them into three groups only: safranin, congo-red, benzopurpurins, etc.; those affecting lignified tissues, collenchyma vessels, and nuclear sheaths —vesuvin, Victoria green, chrysoidin, violet, methyl green, fuchsin, etc.; and stains that merely differentiate, such as Victoria blues B, RRRR, and BB, which color the thickened cells darker than the surrounding tissue, and thus render them more conspicuous. To ensure sections being well stained, all protoplasm, etc., must be got rid of. This is effected with soda lye, washing with much water (acidified with acetic acid if necessary), and then allowing to drain. Afterwards immerse in a $\frac{1}{2}$ to 1 per cent lukewarm stain solution for two or three minutes, and again wash until the water runs clear.

For double staining, first put sections in the stain affecting the lignified tissue, thickened cell-walls, etc., wash well and transfer to stain for parenchyma. This should be heated to 100 C. and rendered slightly alkaline. Colors which are fast on cotton were found to stain parenchyma, whilst those that dye wool or silk directly stain the thickened cell-wall, etc. Suitable mordants (tannin, acetate of lead, etc.) for fixing the colors must be found by experiment.

The sterilization of Milk.—J. A. Forret has examined various methods for the sterilization of milk and finds that

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the best results are obtained by placing the jar containing a pint of milk into a tin vessel filled with 3 pints of water in such a manner that the water and milk are at about the same level when the jar is supported about half an inch from the bottom. The water is then heated until it boils, after which the milk is allowed to remain in the water for 15 minutes. The water should boil in not less than 25 minutes and the milk must be stirred continuously to prevent the separation of the cream.

Plants Growing Under Microscope.—Procure a little *Collomia* seed. Take one of the seeds and with a razor cut off a very tiny slice, place it on a slide, cover with a cover-glass and place under the microscope. The instrument must be in a vertical position. When it is well focused and lighted, moisten it with a drop of water. The seed will absorb the moisture and throw out a very large number of spiral fibers, giving the appearance of veritable germination. Beginners will find it easier if one applies the moisture while the other looks through the instrument.

Storax as a Mounting Medium.—Permanent preparations can be mounted in storax according to Dr. J. H. Piffard if it is prepared as follows: The storax is liquified in a water bath, then filtered through two or three thicknesses of cheese cloth in a hot-water funnel and when cold mixed with an equal weight of xylol. Shake well several times through absorbent cotton or Swedish filter-paper, and evaporate at a gentle heat, to the consistency of treacle. Finally, to each two parts of the fluid, add three parts of naphthaline monobromide, and heat gently until a clear amber-colored fluid is obtained. Probably, the refractive index of the medium should be brought to 1.625 by adding more of the ingredient that may be found deficient, and the product will then be found suitable for work with the highest powers.

Walter White's Botanical Sections.—We have just received from England a new supply of objects and we can furnish at present, almost every number on the list.

BACTERIOLOGY.

Cheese Curd Inflation—its Relation to the Bacterial Flora of Foremilk.—H. L. Bolley and C. M. Hall, use the word “foremilk” to mean the milk from the first part of a milking, not colostrum. Some studies were made on the formation of “pin-holes” in curds which indicated it to be due to the action of bacteria. “Experienced cheese makers have quite generally affirmed that its chief origin is dirty milk.” The work upon which this paper is based reaffirms this belief.” Preliminary cheese curd and fermentation tests were made at two different times with the milk of two cows, using the milk drawn first, the strippings, and the mixed milk of the whole milking. “The evidence from these tests is that the gas-originating organisms were not located in the udders either in the fore or last milk and that the few ‘pin-holes’ of the curds must have had an external origin.”

Studies were then made of the bacterial flora of the milk of 10 healthy cows, living under healthy stable conditions, from January 22 to April 25. In each, samples were taken of the first and last milk of the milking by means of a sterile silver milking tube inserted well up into the milk cistern. As a result, 16 distinct species of bacteria were isolated, some of which were common to both the first and last milk, and others to only one of these. All the microorganisms found were bacteria, and none were found which produced gas. “The work is given as a preliminary study, and may be said to indicate—(1) no bacterial flora common to the animals investigated, save one peculiar non-milk affecting species; (2) that a given form when once present may be quite constant in its occupancy of the udder of an individual animal. Finally, the absence of gas-producing organisms remains unexplained, but adds significance to the previously described curd tests.”

The Constancy of the Kinds of Bacteria in Normal Milk.—H. L. Bolley made, during the summer, cultures of the milk drawn from each teat of three cows. The samples of

milk were obtained in the same way as in the preceding studies, except that in some cases the milking tube was inserted to different depths. About 60 cultures were made. In all, 37 different kinds of bacteria were found representing various physiological types. "As in the previous studies, there is no evidence that the same species are common to different animals, but the constancy of the occurrence of certain types, if present at all, is very apparent. It is plain that the greater number of the germs are found only accidentally at a certain time in a given udder or teat, and perhaps come from the surroundings of the animal. But there are certain single germs which if once found in a teat or udder reappear with a striking constancy."

The Fly as a Germ Carrier.—In 1866, Hoffman demonstrated the presence of tubercle bacilli in the bodies of flies captured in a room occupied by a consumptive. The droppings of the flies were full of bacilli, which were shown by experiment to be fully virulent.

Six years later, M. A. Coppen Jones, of Switzerland, proved by means of chromogenic bacteria that infection can be, and actually is, carried, not only in the bodies of flies, but also by their feet. In the experiment, cultures of the bacilli prodigiosus were mixed with tuberculous sputum. Flies which had been in contact with this mixture were permitted to walk across the surface of sterilized potatoes. In forty-eight hours numerous colonies of the bacillus prodigiosus were visible.

From these results we may reasonably conclude that flies are a constant source of infection.—Modern Medicine.

Infectious Character of the Feces of Tuberculous Cattle.—Scientific research is constantly bringing to light new methods by which tubercle bacilli are communicated to human beings. The *Bulletin Medical* recently published a report of a series of experiments conducted for the purpose of determining whether these bacilli are to be found alive in the excreta of cattle. A young bullock was fed a

meal consisting of bread and a portion of a tuberculous lung. During the three days following, portions of fecal matter were collected and investigated, both by the injection of animals and microscopical examination. Bacilli were constantly found in the feces, and out of fifteen rabbits inoculated, twelve became tuberculous, showing that the fecal matters of tuberculous cattle are as infectious in character as the sputum of persons suffering from this disease.

Rapid Isolation of Bacillus Coli Communis.—Abba gives a new method for “rapid and certain isolation of bacillus coli communis from water.” He prepares the following culture medium: Lactose, 20 g.; dry peptone, 100 g.; sodium chloride, 50 g., and water, 1 liter. This may be solidified by the addition of gelatin. Into a liter of suspected water is placed 100 c. cm. of the previously sterilized culture medium; to this is added 0.5 c.cm. of a one per cent alcoholic solution of phenol-phthalim, and afterward a cold saturated solution of sodium carbonate (usually 2 to 3 c. cm. suffice) until the water becomes of a permanently pink color. This water is placed in five or six Erlenmeyer’s flasks, and incubated at 37 per cent C. At the same time an agar plate is poured, and is placed in the incubator along with the Erlenmeyer’s flasks. . If bacillus coli were present in the water, after twelve, sixteen, or twenty-four hours one or several or all of the flasks will then complete decolorization of the contents. The agar plate is inoculated from the surface of one of the colorless fluids; this is again incubated, and in from eight to twelve hours or less a number of colonies will be visible on the surface of the agar. These colonies are examined under the microscope, and cultures made from the ones which most resemble those of the bacillus coli. Under these conditions the bacillus coli rapidly gains the upper hand over most of the other micro-organisms present in the water. The colonies on the agar plates are usually composed of bacillus coli alone, and the first examination leads to their detection, if present.

Excretion of Micro-organisms.—Biedl and R. Kraus have previously shown that micro-organisms present in the blood are excreted by normal kidneys, the urine being free from albumin or blood. These investigators now record their experiments on the excretion of micro-organisms by the glandular organs. By injecting of staphylococcus into the blood, they have investigated the function of the liver and submaxillary gland in this respect. They found negative results in two of the first four experiments where the gall-bladder was opened immediately after death, the precautions being used. In another series of experiments the bile was inoculated directly into nutrient media, a canula having been placed in the bile passages. In case of the submaxillary gland a canula was placed in the duct, and the same method followed. In all these cases the staphylococcus was obtained from the bile, but the results were negative in all cases where the submaxillary secretion was investigated. The micro-organisms were shown to be continuously excreted in the bile during one and a half to two hours, while the experiment lasted. From these experiments these investigators conclude that as in the case of the kidneys the excretion of micro-organisms is a normal function of the liver.

MEDICAL MICROSCOPY.

On the Action of Antitoxin.—Dr. P. Ehrlich states that by the original conception of the destruction of poisons through the anti-bodies it was considered untenable that in physiologically neutral toxin-antitoxin mixtures both compounds still existed as such, but now two opposite opinions are prominent.

According to one view, poison and antidote exist in the liquids of the tissues as a kind of copulative double compound, which is of course inactive in effect. In opposition to this chemical view it has been held by many, especially Roux and Buchner, that the action of the antitoxins is more indirect. They act on the cells, and these to a certain

extent become immunized against the action of the poison. Having in view the complications which arise in experiments on animals, and with a view to substituting as far as possible the reagent glass for the animal organism, Ehrlich has experimented with ricin, a vegetable tox-albumen, concerning which, he says, there is no doubt that in its principal features, immunity to it is similar to immunity to diphtheria and tetanus. Ricin possesses the property of coagulating the blood. The blood of a rabbit treated with a series of mixtures of ricin in varying proportions, was injected into six mice. In those cases where the mixture gave a precipitate with blood the animals died; in one case, where the precipitate was very slight, the result was not fatal; in the three cases where the antitoxin was (according to the blood test) present in sufficient or excessive quantity to neutralize the toxin, the animal was unharmed. These facts militate against the cellular theory of Roux and Buchner, and tend to confirm the chemical copulative theory of Ehrlich and Behring, at any rate so far as ricin (castor-oil) is concerned.—B. C. Druggist.

The Function of the Suprarenal Bodies.—Dubois has shown that the principal function of the suprarenal bodies is to destroy toxins present in the circulation, especially those resulting from muscular and nervous activity. The glands contain a peculiar ferment which is capable of modifying organic poisons developed by the tissues or of bacterial origin. A considerable quantity of poisonous liquids is found in the glands.

Scarlet Fever by Mail.—Grasset, on investigating the source of infection in an instance in which a child was attacked by scarlet fever in a place where there had been no case of the disease for years, found that, six days before the child was taken sick, the parents had received a letter from its grand-parents stating that another child in the family had had the disease and was peeling. Two flakes of the convalescent's skin were enclosed in the letter. The parents had allowed the child to play with the letter.—*Annales d'Hygiene Publique*.

Physicians can Testify as to Stains.—After an examination thereof, both under a microscope and by a chemical analysis, the supreme court of South Carolina holds, in the homicide case of *State v. Martin*, decided July 11, 1896, that physicians are clearly entitled as experts to give their opinion as to the character of stains found on a piece of floor (*Jour. A. M. A.*). That the latter was not taken from the house in which the defendant lived at the time of the alleged homicide until a few days before the trial, after the defendant had moved from it, and while it was occupied by another person, it is further held did not render it inadmissible in evidence, though the force of the evidence was perhaps weakened by these circumstances.

BIOLOGICAL NOTES.

Rhizopods as Scavengers.—It is interesting to see what a small animal can do as a scavenger. Mr. Thomas Craig, at a meeting of the Natural Science Association of Staten Island, exhibited a bottle, the inside of which had been covered with algæ and a small diatom to such an extent as to make it practically opaque. Upon examination he noticed that a portion near the bottom was clear. A further examination showed that an army of rhizopods were marching in regular order, eating as they went.

The name of the animal is *Centropyxis aculeata*, one of the lobose rhizopods. The animal itself is only a drop of jelly, in which the highest powers of the microscope reveal no organization of any kind, yet it can travel by means of pseudopodia, which are merely parts of the body protruded from any part of it. By the same means it can seize its food, convey it inside its body and then digest it, and when all the nutriment is exhausted cast the refuse out. This it does at any part of the mass as it has neither head nor tail.

This particular animal builds a shell for itself, composed of a material like chitin, and grains of sand on the empty shell of diatoms. The chitin is produced by the

animal and is used to cement grains of sand and other material into the proper form of house for this particular species.

Each species has its own form of habitation and it is rare to find them departing from it. The animal is well illustrated in Leidy's *Rhizopods*.

MICROSCOPICAL NOTES.

Meeting of American Medical Publishers' Association.—The Fourth Annual Meeting of the American Medical Publishers' Association will be held in Philadelphia, on Monday, May 31st, 1897 (the day preceding the meeting of the American Medical Association). Editors and publishers, as well as everyone interested in Medical Journalism, cordially invited to attend, and participate in the deliberations. Several very excellent papers are already assured, but more are desired. In order to secure a place on the program, contributors, should send titles of their papers at once to the Secretary, Chas. Wood Fassett, St. Joseph, Mo.

NEW PUBLICATIONS.

Bacteria in Rocks.—M. B. Renault has long worked at the indications of bacteria found in geological strata, and now publishes the general result of his observations in a paper illustrated with a large number of drawings. As might be expected from their simple structure, bacteria appear to have been coeval with the first appearance of organic life on the earth, the coccoid form being apparently earlier than the bacillar. Indications of their presence are found in bone, teeth, scales and coprolites, as well as abundantly in vegetable tissues, the spores and sporanges of ferns appearing to have been especially subject to their attacks. The species are, as a rule, distinct from those at present in existence.—*Ann. des Sciences Naturelles*.

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MR J C SMITH IN HIS STUDY

THE AMERICAN
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No. 4

Notes on Some New, or Presumably New, Infusoria.—I.

By J. C. SMITH, OF

NEW ORLEANS, LA.

[WITH FRONTISPIECE]

The classification followed in this paper is that adopted by Saville Kent in his "Manual of the Infusoria."

Family.—Actinomonadidæ. S. K.

Genus.—Actinomonas. S. K.

Species.—Actinomonas primus (figs. 1, 2, and 3).

Body in active flagellate stage cylindrical, variable in form, usually obovate with the posterior continued as a caudal prolongation, sometimes ovate and at other times irregular in shape and nodulate; the largest and usual obovate form about twice as long as wide; flagellum single anterior, equalling one longest body length and vibratile through its whole extent; contractile vesicle conspicuous and located in posterior body half; nucleus round and subcentral; endoplasm hyaline containing to a greater or lesser extent, a number of bead-like granules of a blueish tint, presumably food; locomotion equable, fairly rapid and by revolution on long axis.

Size 1-1250 inch. Habitat—Infusion of aquatic plants.

Body in Heliozoan stage variable in form, usually subglobose and undergoing slight changes of contour; rays numerous, fine and projected from all parts of the periphery; equalling in length from one to two diameters of the zooid; flagellum quiescent and coiled close to the body.

This remarkable form was found very abundant and was given prolonged study. In the active flagellate stage it moved about in an easy manner, revolving on its long axis; the flagellum being thrown into graceful curves from its origin to its distal end. After moving about for an hour, more or less, the coming change to the heliozoan stage was ushered in by a slower movement, an occasional halt, slight tremors and the appearance on the anterior body half of short, heavy and blunt tentacle-like processes, with a simultaneous contraction of the body.

If the endoplasm was well filled with the granules mentioned, the body would be modulated. The rays then extended until as long as one or two of its diameters; the tentacle-like processes covering the anterior half, going to form the anterior rays; the flagellum becomes inactive and is coiled close to the body. In this state it resembled very much a light colored *Heterophry* Leidy, changing its contour gradually and almost imperceptibly, but never to any great extent.

The change from the heliozoan to the flagellate stage is heralded by the gradual withdrawal of the rays, the flagellum uncoiling and having a slight movement, a few slight quivers of the body and simultaneous elongation to the original shape of the flagellate; the flagellum becomes very active at once and the infusorian darts off to live for an hour or so in this phase. Sometimes the original form is not restored entirely until it has moved about for a short while, but in all cases observed the original shape was finally assumed.

Each one of the phases of this dual life, as witnessed by the writer occupied from fifteen minutes to one and a half hours.

While in the heliozoan stage the manner of capturing and engulfing food is identically the same as when performed by the *Actinophry* sol. One form that was un-

der observation for four hours underwent five changes and during the heliozoan phase captured and engulphed six large forms of *Hexamita inflata* (which were abundant), three forms of *Cercomonas longicauda* and two forms of *Heteromita lens*. From this and a number of similar observations the writer feels justified in concluding that this infusorian is truly carnivorous.

Larger infusoria and those of greater consistency when in contact with the rays were visibly affected; they seemed to experience a shock, changed their routes and slackened their pace. A number of large forms of the very active *Trepomonas agilis* were often found among the rays and were not affected in the slightest manner. Defecation was observed during both stages, but the flagellate form was never seen to take food.

During the heliozoan stage this form has no locomotive movement and is not anchored in any way; this last assertion is clearly demonstrated by its being at the mercy of every current produced by a passing infusorian, worm or rotifer.

Saville Kent, in his manual of the Infusoria, mentions an observation of his wherein he witnessed the development of an Actinophry from a flagellate zoospore. In his figure of the zoospore the contractile vesicle is placed in the posterior half, and in his figure of the Actinophry the nucleus is central. The position of these two essentials corresponds with the form here described. It may be presumptuous, but the writer cannot help but incline to the belief that if the Actinophry had been given a prolonged study it might have reverted to its original flagellate state and thus have rendered this record of a new form unnecessary.

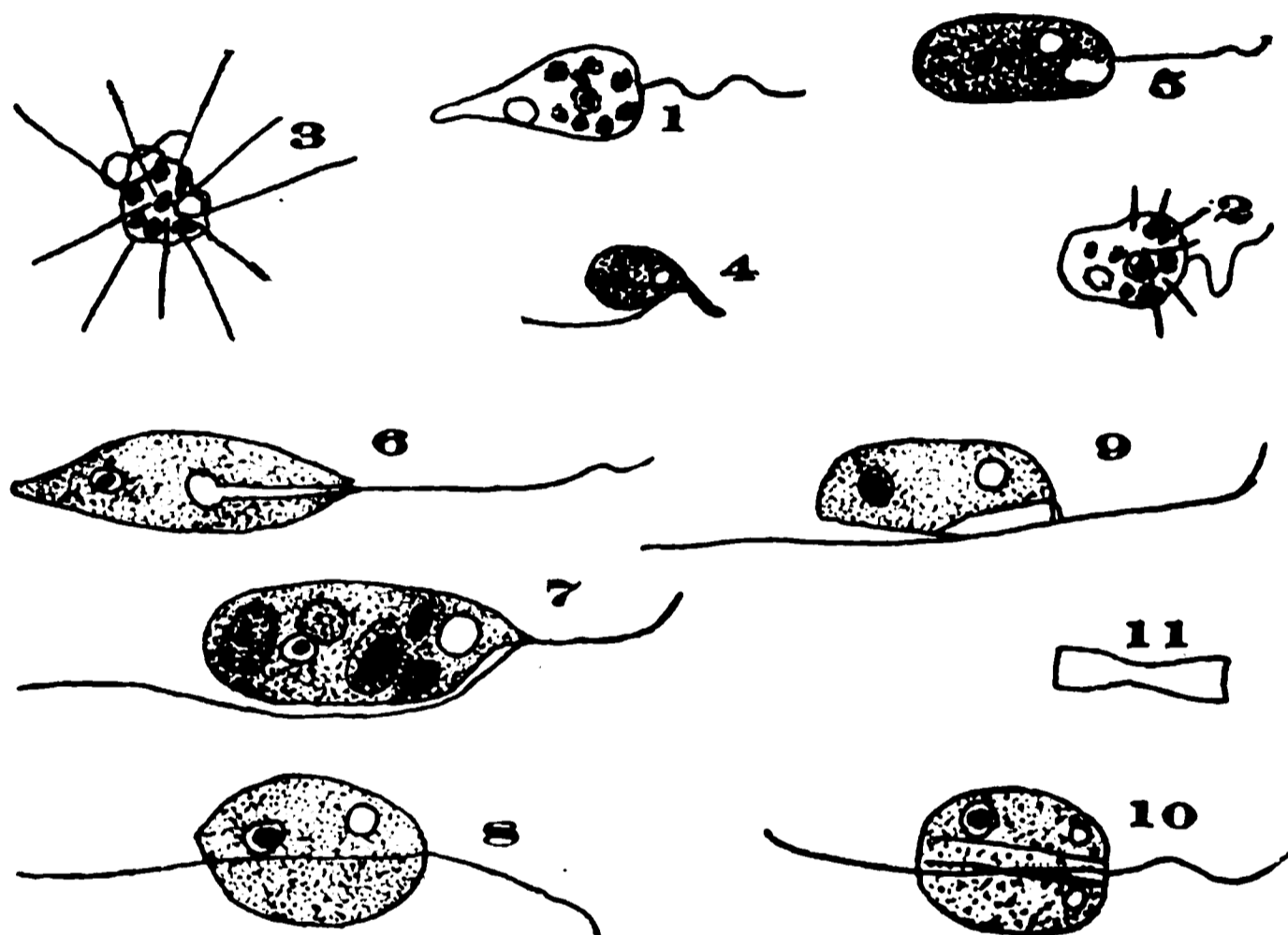
Family.—*Heteromitidæ*. S. K.

Genus.—*Heteromita*. Dujardin.

Species.—*Heteromita ligulata* (fig. 4)

Body ovate, cylindrical; one and a half to two times

as long as wide; plastic and changeable in shape; ventrum slightly concave anteriorly; flagella originating together at the anterior extremity, the anterior vibratile flagellum nearly one half the body length; this flagellum is heavy strap-like and of uniform thickness from its origin to its distal end; the trailing flagellum from two to two and a half times the body length; contractile vesicle



- 1.—*Actinomonas primus*. x 900.
- 2.—*Actinomonas intermediate* sp. n.
- 3.—*Actinomonas*. Heliozoan phase.
- 4.—*Heteromita ligulata*. x 1100.
- 5.—*Petalomonas pusilla*. x 2250.
- 6.—*Atractonema fusiformis*. x 1750.
- 7.—*Diplomastix rostrum*. x 1400.
- 8.—*Diplomastix agilis*. x 1200.
- 9.—*Diplomastix* latero-ventral view.
- 10.—*Anisonema disomato*. x 1250.
- 11.—*Anisonema*. Transverse section.

conspicuous and situated close to the anterior extremity; nucleus round and located in the posterior body half; endoplasm, hyaline and slightly granular; locomotion slow and equable while the anterior strap-like flagellum is constantly and rapidly wagged. Size from 1-5000 to 1-3000 inch.

Habitat—Ubiquitous. Transverse fission.

This infusorian has been found by the writer in all kinds of water, fresh and stale, in animal and vegetable macerations; sometimes in great abundance. The anterior flagellum is heavy and strap-like, and is different from any appendage found on any of the flagellata, so far recorded. The movements of this flagellum are more like the wagging of the tail of a pleased dog than the ordinary vibratile movements.

At times this flagellum is bent backwards on either the dorsum or ventrum and no matter how rapid the movements are it does not in the least seem to accelerate the even gliding movements of the body. While the writer has observed a perceptible increase of the granules of food in the endoplasm, he has never been able to detect the inception of such food, but he has a strong presumption that such inception takes place in the slight concavity existing just behind the origin of the flagella on the ventral surface.

Family.—Paramonadidæ. S. K.

Genus.—Petatomonas. Stien.

Species.—Petalomonas pusilla (fig. 5).

Body subovate, twice as long as wide; flattened and without a furrow or ridge; Anterior slightly narrower than the posterior; both extremities rounded; sinistral border of greater convexity than dextral border; flagellum equalling a little more than one body length and directed forwards, in a straight line and stiff manner, the distal end vibratile; contractile vesicle conspicuous and located well forwards in the anterior body half and near to the sinistral border; nucleus round and situated, medianly, in the posterior body half; Endoplasm, hyaline and slightly granular posteriorly; locomotion same as all the species; Size 1-3000 inch. Habitat—stale infusion of aquatic plants.

This form is evidently the smallest of the genus so far recorded. Kent in his "Manual of the Infusoria" men-

tious a form—*Petalomonas irregularis*, observed by himself, which although being a bit larger than this one, bears a close resemblance. He failed to locate the contractile vesicle and the nucleus and in consequence leaves a doubt as to whether his *Petalomonas irregularis* is the same as this form. This infusorian is dissimilar from any other of the species so far recorded, in being devoid of a ridge and of a furrow. When first observed, the writer was inclined to place it among the genus *Paramonas*, but on closer examination it was found to conform in every detail of habit with the genus in which it is placed.

Family.—*Paramonadidæ*. S. K.

Genus.—*Atractonema*. Stien.

Species.—*Atractonema fusiformis* (fig. 6).

Body fusiform, cylindrical, more than twice as long as wide; widest at the center and attenuate at both extremities; the anterior transversely truncate; posterior obtusely pointed and at times produced in a nipple-like process; pharynx distinct and extending backwards, meeting the contractile vesicle, which is conspicuous and centrally placed; flagellum more than one body length; nucleus round and medianly placed in posterior body half; endoplasm hyaline and slightly granular; locomotion slow and even. Size 1-1400 inch. Habitat—Pond water with algæ.

The small size and the ratio of width to length are all that make this form different from *Atractonema teres*. Stien.

Family.—*Anisonemidæ*. S. K.

Genus.—*Diplomastix*. S. K.

Species.—*Diplomastix rostrum* (fig. 7).

Body elliptical, cylindrical and variable in size; from one and a half to three times as long as wide; anterior truncate obliquely to ventrum; this truncation being slightly concave and producing the anterior into almost

a point ; posterior evenly rounded ; oval aperture inconspicuous but very capacious, situated in the truncation ; flagella originating together at the apex ; the anterior one equalling one-half the body length and the posterior one twice the body length, and much heavier ; contractile vesicle large, very conspicuous and located well up in the anterior body half ; nucleus round and in posterior body half ; endoplasm intrinsically clear and of a blueish tint, but generally filled with large food grains ; locomotion exceedingly rapid and by revolution on long axis. Size from 1-2500 to 1-1100 inch. Habitat—Putrid vegetable macerations. Transverse fission.

The movements of this infusorian are so rapid that a view of the flagella is made very difficult ; especially is this so in respect to the anterior shorter one. At times the posterior longer flagellum is twined about the body. The oval aperture would never be suspected to exist if the infusorian was found feeding on bacteria ; it is only when seen engulfing or attempting to engulf large particles of food that the position and capaciousness of the oval aperture can be demonstrated. The writer had under observation a specimen that made quite a number of attempts to swallow food more than thrice its own dimensions. Where it is found with abundance of food the nucleus and contractile vesicle are obscured by the large globular food grains it contains. It is a veritable scavenger. A dead *Plurionema* has been seen surrounded by dozens of them intent on devouring the remains as rapidly as possible.

Family.—Anisonemidæ. S. K.

Genus.—Diplomastix. S. K.

Species.—*Diplomastix agilis* (figs. 8 and 9).

Body sub-obovate, compressed ; less than twice as long as wide ; dextral border of greater convexity than sinistral ; anterior slightly truncate transversely ; dorsum convex

and ventrum plane; the anterior half of the ventrum traversed by a slight concavity which includes about one-half the body width; flagella originating together near the center of anterior border; the anterior flagellum equals one body length and is directed obliquely forward to the right side; the anterior third of this flagellum is vibratile and is flexed still further to the right side; the posterior flagellum equals nearly two body lengths; oval aperture capacious, situated at the base of the anterior flagellum and conspicuous only when the infusorian is engulfing or attempting to engulf large particles of food; contractile vesicle large and very conspicuous, located in the anterior body half near the sinistral border; nucleus roundish and sub-central; endoplasm blueish and extrinsically granular; locomotion smooth and rapid gliding. Size 1-1400 inch. Habitat—Pond water with algæ.

This exceedingly active infusorian was found in a number of different collections of water taken from a pond in one of the parks in New Orleans. At no time was this form observed until the water had become stale. The oblique direction of the anterior flagellum is not unlike the same appendage of the genus *Petalomonas*. The ventral concavity is well seen in a latero-ventral view, which it often presents, as it has the habit of gliding through and about debris heaps, after the manner of an *Aspidisca*, but in a hurried and nervous sort of way. The position and capaciousness of the oval aperture can be verified only by observing the infusorian swallowing or attempting to swallow large particles of food. It often undertakes to swallow particles of food much larger than itself. After it has taken any large particle of food it immediately becomes much altered in shape—but after a few contortions becomes itself again; it is at this time only that it demonstrates its flexibility.

Family.—Anisonemidæ. S. K.

Genus.—Anisonema. Dujardin.

Species.—Anisonema disomata (figs. 10 and 11).

Body sub-elliptical, less than twice as long as wide; anterior extremity slightly wider than the posterior, and narrowly truncate centrally; posterior rounded; dorsum and ventrum flat and both traversed longitudinally by a deep groove which occupies nearly one-third of the body width; these grooves seem to cut the body in equal halves; flagella originating together near the frontal border and on a line with the slight anterior truncation; the anterior one equals one body length while the posterior one is near two body lengths; contractile vesicles, two, small and located in the anterior body third, one on each side of the grooves; nucleus roundish, in the posterior half near the sinistral border; endoplasm granular and of a greenish tint; locomotion exactly as with *Anin-nema grande*. Ehr. Size 4-1666 inch. Habitat—water from a flower pot.

This form was taken in fairly large quantities from water of long standing in a flower pot exposed to the weather. The grooves give to the infusorian a very transparent line extending the full length of the body. It is when the anterior is depressed and there is a consequent elevation of the posterior border that these grooves can be well observed. The lateral borders of this form are not rounded, but instead are cut off at right angles to the dorsum and ventrum (fig. 11).

The resemblance that this form bears to the *Anisonema solenotus* of Dr. Stokes is striking and apart from its smaller size would require careful scrutiny to distinguish. The writer has on numerous occasions taken the *Anisonema solenotus* of Dr. Stokes from pond water in the Audubon park in New Orleans and has thus been enabled to compare them.

(To be continued.)

Some Experiments on the Growth of Diatoms.

BY GEORGE C. WHIPPLE,

NEWTON CENTRE, MASS.

In a paper published in 1894 the writer suggested an explanation for the peculiar seasonal distribution of diatoms in lakes and ponds. It was shown that in deep ponds these minute plants are found abundantly during the spring and fall, but are almost entirely absent during the summer and winter; that these growths are closely connected with the phenomena of circulation and stagnation of the water, which phenomena are due to temperature changes; and that it is during the periods of the year when the water is in complete circulation throughout the vertical that the diatom growths occur. The explanation offered for these facts had reference chiefly to the food supply. It was stated that diatoms require a sufficient supply of nitrogen in the form of nitrates, and that they require a free circulation of air, and it was shown how during the "periods of circulation" in the spring and fall these conditions were fulfilled. In the light of more extended observations and experiments this food supply theory, taken alone, is seen to be inadequate, and while it is true that the question of food is one of fundamental importance, yet there are other factors which materially influence their growth. With a view to determining the nature and effect of some of these influences the writer has conducted recently several series of experiments, some of the results of which are here presented.

It is not an easy matter to cultivate diatoms successfully in the laboratory to obtain comparative results. They are organisms which have an extremely sensitive nature, and slight changes in their environment often make great differences in their growth. The temperature, the amount of light, the shape and size of the jar in which they are grown, the action of the glass upon the

water, etc., are all disturbing elements affecting their growth.

In order to determine the effect of light upon their growth it was found necessary to make experiments in the open reservoirs under conditions practically the same as those found in nature.

The method employed was an extremely simple one. It consisted of suspending bottles filled with water from the same source at different depths in the pond, the bottles being tied to a rope which hung from an anchored buoy. After a certain time the bottles were drawn to the surface and the water examined, records being kept of the number of diatoms in each sample before and after exposure. The bottles varied in capacity from 150 to 1,000 cc. In the first five experiments they were tightly stoppered, but in the later ones silk bolting cloth was tied over the mouths of the bottles, and inverted glass tumblers were placed above. The latter arrangement gave much heavier growths on account of providing better opportunity for the circulation of air and for the renewal of food supply.

Without describing the experiments of [Forel Forel, F. A. "Le Leman, monographie limnologique," Lausanne, 1895] and others upon the intensity of light at various depths, it may be said that the decrease in the intensity below the surface is due to two causes—absorption by the water, and the presence of fine particles which act as a screen. The reduction of light in passing through water is supposed to follow the law that as the depth increases arithmetically the intensity of the light decreases geometrically. For example, if the intensity of the light falling upon the surface of a pond is represented by 1, and if $\frac{1}{2}$ of the light is absorbed by the first foot of water, then the intensity of light at the depth of one foot will be $\frac{1}{2}$; the second foot of water will absorb $\frac{1}{2}$ of $\frac{1}{2}$, and the intensity at a depth of two

feet will therefore be 9-16, and so on. At this rate of decrease the intensity of light at a depth of ten feet will be only about 5 per cent of that at the surface.

The following experiments selected from the series may be cited as a typical example of the results obtained:

Cochituate water located in the Chestnut Hill Reservoir, April 29 to May 13, 1895. Temperature, 53°-62°. Color, 0.58.

Date.	Depth.	Asterionella.	Melosira.	Stephanodiscus.	Synedra.	Tabellaria.	Total
April 29	All depths.	94	196	3	11	15	319
May 13	2 ft.	4,040	910	20	22,010	550	27,530
May 13	4 ft.	570	80	10	6,800	120	7,580
May 13	6 ft.	380	650	26	4,510	284	5,850
May 13	8 ft.	650	840	26	1,304	100	2,920
May 13	10 ft.	154	1,380	10	80	0	1,624
May 13	25 ft.	16	132	0	88	28	264

On April 29, the bottles were filled with water from the same source and suspended in the reservoir at the depths indicated in the table. On that date the water contained 319 diatoms per cc. After an exposure of two weeks the bottles were drawn to the surface and the water examined, with the result that the samples near the surface showed an abundant growth, while those which had been kept at a greater depth showed but a slight increase.

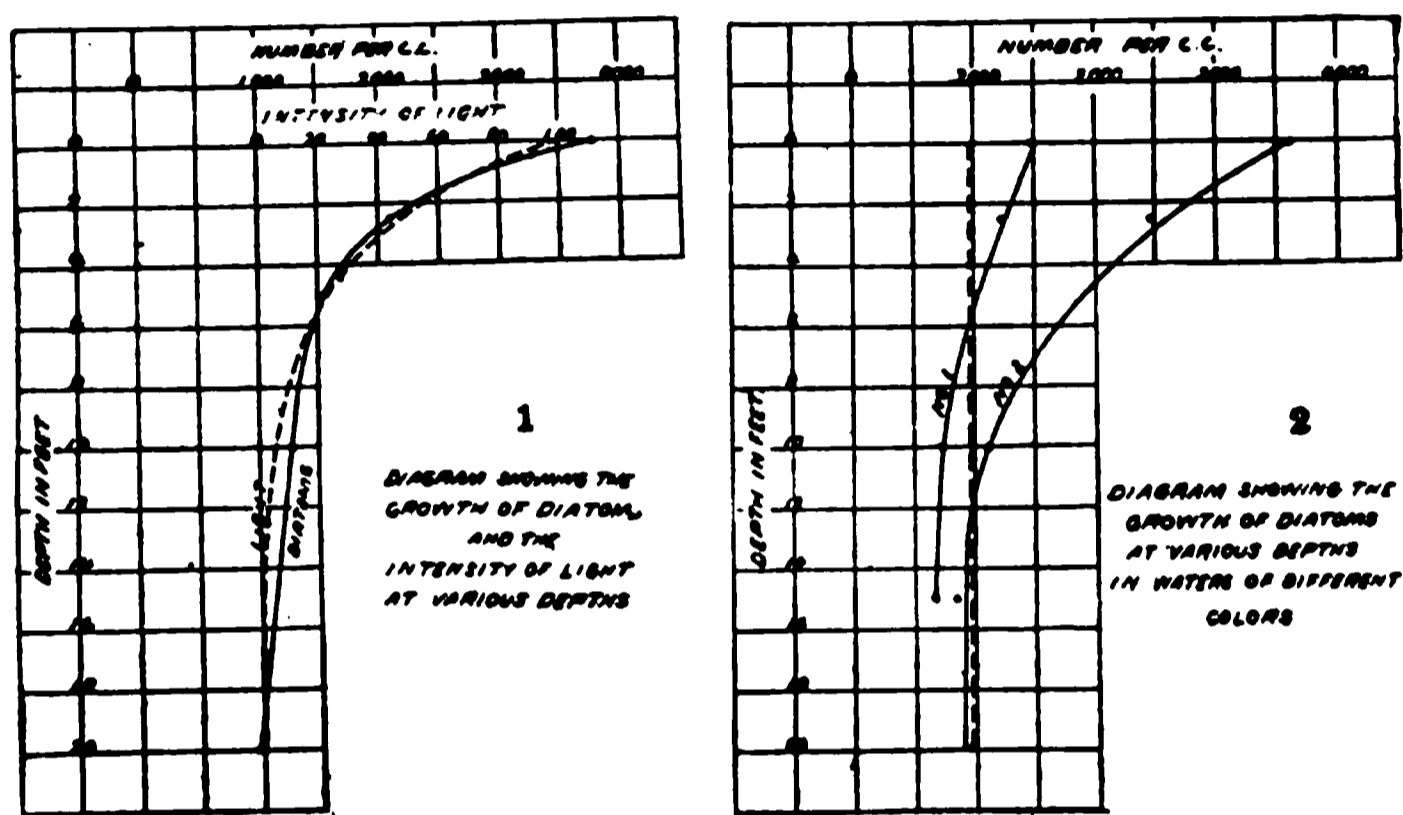
The temperature of all the samples was the same and the only facts that varied were the intensity and quality of the light.

In order to better appreciate the relation between the intensity of the light and the diatom growth we may consider fig. 1.

This diagram shows the relative diatom growths at various depths and the corresponding intensity of light

calculated from experiments upon the coefficient of absorption of light by water. The parallelism of the two curves is very striking.

One of the objects of the experiments was to determine the depth below which the diatoms are unable to develop. The results show what we should naturally expect, that it depends upon the character of the water,—its color, turbidity, etc. This is illustrated by fig. 2, which



EXPLANATION OF THE DIAGRAMS.

Figure 1—Lake Cochituate water located in Lake Cochituate, Nov. 29, 1895. Examined Dec. 9, 1895. Temperature 40° - 44° . Color 0.33. The intensity of light at different depths was calculated on the assumption that a layer of water one foot in depth absorbs 25 per cent of the light falling upon it.

Figure 2—Lake Cochituate water located in the Chestnut Hill Reservoir and in Lake Cochituate. The curves represent the average of two series, the first from Nov. 22 to 29, the second from Nov. 29 to Dec. 9, 1895. Temperature 40° to 46° . No. 1. C. H. Res. Color 0.87. No. 2. Lake Cochituate. Color 0.33. The Diatoms referred to in both diagrams were chiefly *Asterionella* and *Melosira*.

shows the results of two series of experiments upon water of the same kind located in Lake Cochituate and Chestnut Hill Reservoir. The former had a color of 0.33, while the color of the latter was 0.87. The difference between the two series is very striking. In the light colored water the growths were heavier and extended to greater depths than in the darker water.

Curve No. 1 represents the growths in Chestnut Hill Reservoir, and curve No. 2 those in Lake Cochituate.

The number of diatoms in the original sample is shown by the broken line. The point at which this broken line cuts the curves may be called the limit of growth. In Lake Cochituate this point was at a depth of about twelve feet, in Chestnut Hill Reservoir, six feet.

Diatoms are said to be positively heliotropic, that is, they tend to move towards the light. In some species this power is quite strong; in others it is less noticeable. For the purpose of determining the heliotropism of the diatoms commonly found in water supplies, samples of water rich in diatoms were placed in brass tubes three inches in diameter and thirty-two inches long, having glass ends. One end was covered with a black cap, and the other end exposed to the light. After varying lengths of exposure, portions of the water were drawn from each end of the tubes and examined microscopically. As an example of the results obtained the following may be quoted. Cochituate water containing 922 diatoms per cc. was exposed in a tube for twelve hours. At the end of that time the water at the light end of the tube contained 1,438 and that at the dark end only 320. Some of the tubes were inclined, to see if the diatoms would move upwards towards the light; some of them were placed vertically; in others the diatoms were given time to settle before the exposure was made. The experiments showed that most of the common genera tended to move towards the light while settling, but that having once reached the bottom of the tube they remained where they fell. They apparently did not possess the power of moving upwards towards the light—certainly not through any great depth of water. But while they could not rise of their own accord, slight currents of convection caused by varying the temperature of the water sufficed to keep them near the surface.

The bearing which these facts have upon the seasonal distribution of diatoms is obvious, and we are now better

able to understand why it is that their growths occur during those seasons of the year when the water is in circulation throughout the vertical. During those periods not only is food more abundant, but the vertical currents keep the diatoms near the surface, where there is light enough to stimulate their growth, and where there is an abundance of air. If this theory be true, it must follow that the weather has a marked influence upon their growth. We should expect that the greatest growths would occur on warm, fair days, when there is just enough wind to keep the diatoms near the surface. On quiet days we should expect that they would sink in the water, perhaps below the limit of their growth. During a long period of quiet weather they might sink even to such a depth that they would not again be able to reach the surface.

This is just what took place in Lake Cochituate in the spring of 1895. In this lake there is almost invariably a heavy spring growth of diatoms, but in 1895 the growth was small. It began as usual, the diatoms being apparently in good condition. Early in May, however, there were a few days of uncommonly warm weather. The temperature of the air went above 90°, and the temperature of the surface water on one day was 76°. For almost a week the water was very calm. During this calm weather the diatoms settled rapidly, disappearing almost entirely from the surface. In the meantime the water became stratified, on account of the high temperature of the surface layers, and when once more the wind began to blow, its influence was felt only ten or fifteen feet below the surface. The diatoms, having settled below that depth, were unable to rise, and consequently their growth ceased.

On a Fossil Lake in New Jersey.

By ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

[Read before the Washington Microscopical Society.]

I wish to record here the finding of a fossil lake in New Jersey; first, because it gives me an opportunity of clearing up the knowledge of infusorial earths and also because I found in it two strata of fossil bacillaria, commonly called diatomaceæ, one below fresh-water and one above brackish water forms. Beside these are growing now and depositing their shells, fresh-water bacillaria. This was the first that I can find containing the fresh and brackish water layers of bacillaria, and should be recorded for that reason alone. But I was, therefore, led to study closely the genesis of similar infusorial earths and I have come to the conclusion that they all, in this country as well as in Europe, are the same lithologically and the same in the forms of bacillaria seen in them.

The earth is clay and so are all of them in North and South America and in Europe. When discovered, it was communicated to the San Francisco Microscopical Society on the 21st of January, 1891. I then called it an intra-glacial deposit, it being supposed that it lay between the two glacial moraines which I supposed were here in New Jersey. But then I studied the glacial moraine and I found there was but one in this part of the state. I also learned that glacialists were inclined to place but one in the east, although they were doubtful if there were two in the west. I now call it Iceberg period clay, being formed when the ice of the glacial period was melting and broke into icebergs on the margin. This margin moved further north as the ice melted and at last disappeared. When I found the earth, it was just developed, being turned up by the Lehigh Valley railroad forming a bank across a marsh which I learned had been a lake formerly.

Weequachick lake was known to the Indians but has disappeared now, being left as a marsh with clear places in it where the water was clear but shallow. It is at Waverly, about four miles from Newark and close to Elizabeth. I found first that they were digging for the railroad just south of the Marsh and almost a yard down they turned up a dark, almost black soil. This I secured and examined. I was delighted to find that it consisted of nearly pure brackish water forms of bacillaria. Going to the place where they were digging to secure some more of the earth, I saw that the embankment which was formed of glacial moraine, in this case being in the majority of sand and gravel, had been laid across a marsh which I also learned had been called Weequachick lake. But the soil at the bottom had not been firm enough to bear the weight of the embankment which had sunk, crowding up the bottom of the marsh. At one place, it rose in miniature hill, about six to eight feet high. In this place, I collected it, and found it was peaty on top, and, for five feet down, it contained brackish forms of bacillaria, and below that for at least two feet it was made up of fresh-water forms. Beneath all was the glacial moraine which at this place is over thirty feet thick. Where the fresh-water and the brackish water bacillaria joined, there was a mingling of forms, so that one could collect a fresh water infusorial earth having some salt water found in it. Thus, I got *Navicula viridis* and other forms along with *Triceratium favus*.

Then I studied the infusorial earths which I had or could procure and I got over a hundred and I found that they all contained essentially the same fresh-water forms. And I collected any clay that occurred everywhere in New Jersey and I found it contained sparsely the same forms. And I came to the conclusion that they were all one in the Iceberg period clays of the world. This is the conclusion I have come to now.

The Microscopical and Chemical Aids to Diagnosis.

BY DR. KATHRINE R. COLLINS.

On October 14th, 1896, before the Tristate Medical Society at Chattanooga, Dr. Kathrine R. Collins read a paper on "Microscopical and Chemical Aids to Diagnosis." The writer takes the position that by these two means valuable assistance to diagnosis may be obtained, but at present it is, too often, the case that these examinations are hurriedly and carelessly made thus bringing about very unsatisfactory results. The examination of one specimen of urine being frequently considered all that is necessary, not as the abnormal constituents of the urine may occur without any coexisting pathological condition, as the presence of sugar or albumen after a meal rich in these substances, the one examination is without value. Also in the microscopical work many conditions may be overlooked in the single examination or the presence of the tubercle bacilli in the sputum of tuberculous patients. Attention is then called to some of the difficulties interfering with the tests for sugar in the urine; the value of estimating the amount of chlorides excreted in pneumonia; the presence and value of the Drazo-reaction in typhoid fever, pulmonary tuberculosis, puerperal conditions and concealed septic processes, the progress of structural diseases of the kidney being marked by the amount of urea present, a diminution, showing non-elimination and consequent absorption.

In the examinations of the sputum, the Lurshman-Leyden spirals in bronchial affections, the Charcol-Leyden crystals in bronchial asthma, the elastic fibres and the tubercle bacillus. The presence of the Klebs-Löffler bacillus of diphtheria should be demonstrated in every case of that disease, as it will lead to a sharper line being drawn between true diphtheria and these throat affections that simulate the disease. The pneumococcus

of Fraenkel while not yet proven the sole cause of pneumonia is considered by many authorities to bear a casual relation to the disease. Going on to the blood examinations, here the condition, number and relation of the red and white blood corpuscles are the only means by which we can distinguish between chlorosis and anæmia, and anæmia and leukæmia. While Laveran's experiments in 1880, demonstrating the presence in the blood of the plasmodia malarie, have been corroborated by other investigators in his own country and by many in this, he thus made malaria a definite disease. The Doctor proceeds to speak of the revolution of opinions in regard to the causative factor in typhoid fever. Babes and Brieger are quoted as expressing doubt as to the Eberth bacillus being the sole and only cause. Babes fails to find it in every case, while Brieger claims a mixed infection. Vaughan, of this country, in 1890, made experiments and demonstrated the presence in drinking water obtained from the source of the water supply of a town suffering from a severe epidemic of typhoid fever, of a number of germs capable of producing in rats and guinea pigs the characteristic symptoms of typhoid fever, and invariably fatal. Some of these germs found in the spleen after death, respond to the tests for the Eberth bacillus. Vaughan concludes from this that there are found in certain waters a number of germs capable of producing typhoid fever, and that the Eberth bacillus is an involution form of any one of these. In conclusion the Doctor urges the profession in the report of all cases to add the results of microscopical and chemical analysis of the excretions and secretions indicated.—*Charlotte Medical Journal*.

Liquid Metal Polish.—Take 8 ounces of rotten stone, 2 ounces oxalic acid, 3 ounces cotton seed oil and add benzine enough to make the mixture of the required consistency.

EDITORIAL.

Cigarettes.—An analysis at the Department of Agriculture showed: Ash 13.00, water 13.00, ammonia .05, nicotine 1.20, oils and fats 5.00, fiber 6.00, sugar starch 50.00, pretreated matter 12.50. No opium or arsenic was found after analyzing samples of all the common native brands. The opponents should confine their charges to the injurious effect of the nicotine upon the nervous system and upon the heart. It disturbs the regular systole and diastole of the heart and changes the beat to a muffled flutter. After the cerebral exhilaration and exaltation produced by smoking, come with the lapse of hours irritating and debilitating or soporific effects, which give way under the exhilaration of another smoke but persist unpleasantly unless treatment is granted. A body subject to such alternations cannot stand during 25 years what it could have stood if freed from them.

Good Water.—Koch said that water is good unless it contains over 100 microbes to the cubic centimeter. Frankland says that there may be many more in good water.

Typhoid Germs.—Dr. Frankland put typhoid germs into deep well water, into Thames water and into Lake Katrine water. The bacilli died more rapidly in Thames water than in the lake water while they persisted longest in the deep well water. The longevity of the germs was proportional to the freedom of the water from other inhabitants.

MICROSCOPICAL APPARATUS.

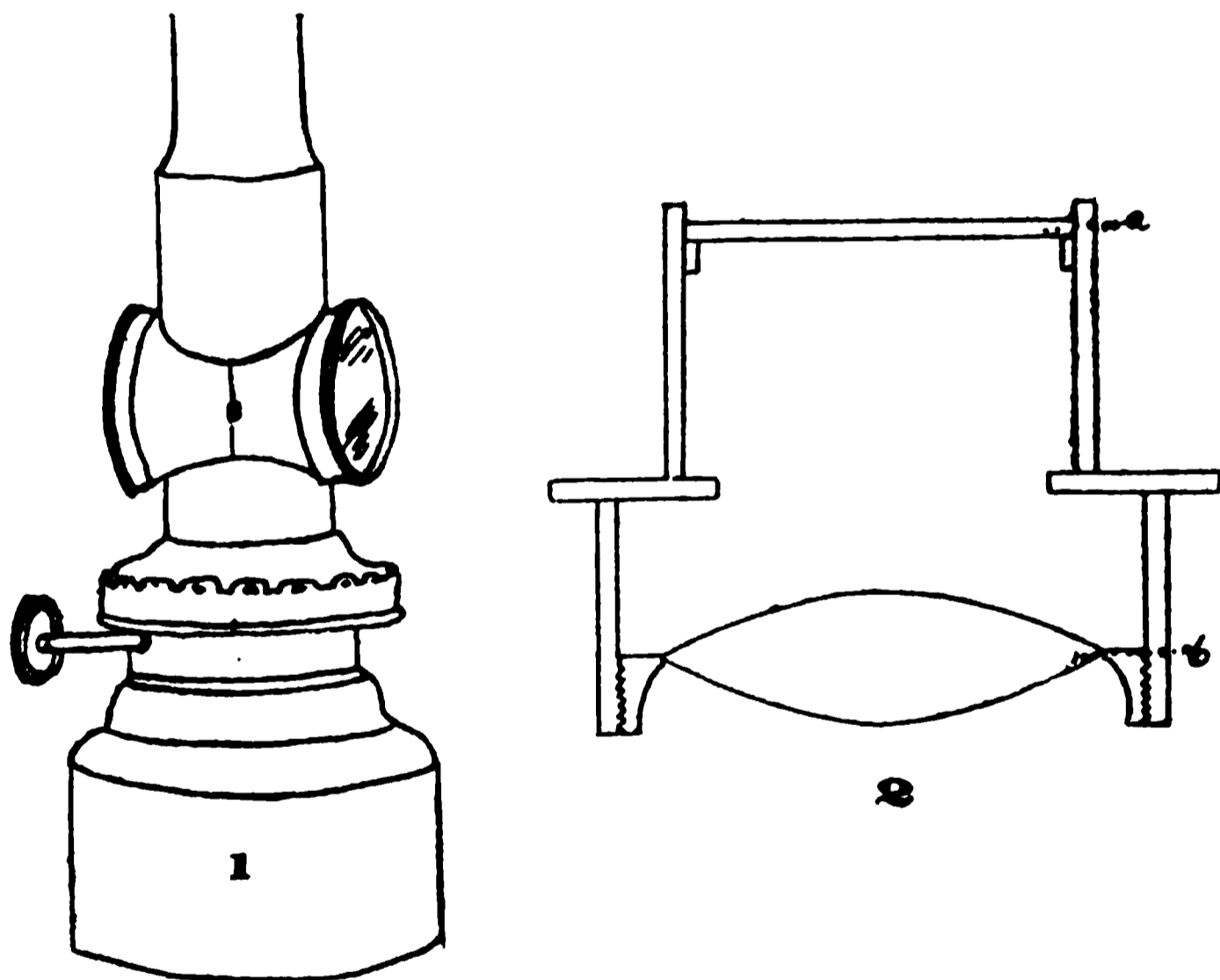
A New Microscope Lamp.—This excellent lamp, which combines portability with great efficiency, was designed and exhibited at the meeting of the Quekett Microscopical Club, on the 16th of last October, by Mr. W. Goodwin, a member of the club.

The lamp which is nickel-plated, is 2 $\frac{1}{8}$ in. in diameter 6 $\frac{1}{2}$ in. in height, and weighs about 3oz. A glance at the

figure shows that it has a metal chimney with two openings : this makes it available for the illumination of two microscopes at the same time. The burner takes a $\frac{1}{2}$ in. wick, which yields sufficient light for an amplification of 2,000 diameters when a suitable condenser is used.

The glasses are optically worked, one being tinted steel-blue, the other signal-green ; if, however, untinted light is desired, circles of thin cover glass may be used instead. These, if carefully selected, will stand the heat of the flame without cracking.

The lamp is so small that it can easily be packed in the same case with the microscope, thus dispensing with an



extra box. The price of the lamp is about 12s., and it is made by Mr. H. Hinton, 12 Vorley-road, Upper Holloway, N.—*English Mechanic*.

A Simple Means of Illuminating Objects with Low Powers of Artificial Light.—The following is a simple means of obtaining a pleasant equably lighted field with sufficient intensity and of such a tone as to permit of a prolonged examination of low power specimens without fatigue.

Such an illumination was felt to be a desideratum in quite early microscopical days, and in all the older textbooks will be found descriptions of apparatus to serve this end, ranging from simple contrivances like waxed paper, ground glass and plaster-of-Paris mirrors to light modifiers, reflector screens, white-cloud condensers, double parabolic specula, and many more elaborate devices. It is pretty obvious, therefore, that nothing new or striking is likely to be invented for the purpose now, when the tendency is to diminish rather than multiply apparatus.

The idea is to intensify the light and then spread it over a large surface. For the intensification I use the lower, crossed lens of the Abbe condenser, (fig. 2, b) but any suitable fairly large lens of about one inch focus will do as well, either a double convex or the field lens of an eye-piece. This is screwed into the lower end of a piece of tube fitting the sub-stage, or under stage ring, which tube should be a little longer than the focal length of the lens employed. Just below the upper end of the tube is a split ring serving as a ledge, and on this, in the focal plane of the lens, rests a circle of thinnish glass lightly ground on one surface. The light from the flat of the lamp is condensed by the bull's-eye on the mirror, thrown up through the lens and focussed on the ground glass, (fig. 2, a) which is racked or pushed up until almost in contact with the slide. The image of the flame being broken up at every possible angle by the ground glass, with a little manipulation one can fill any sized field with a most pleasant soft light, which can be employed for a long time without detriment to vision. It was long ago discovered, that freshly-ground glass possessed a peculiar property of soft brilliancy which the commercial product did not, and I get circles of the required size from the glass-cutter and grind them myself with a little fine emery and water on another piece of glass until just sufficiently abraded to stop any direct pencils. Besides the ordinary white glass it is a great advantage to get some circles cut from different tints of blue or smoked glass, and either grind these

on one surface in the same way, or temporarily cement them to the unabraded surface of the ground glass, by a drop of cedar oil or glycerine; one thus obtains a series of tones suited to all sorts of objects.—*Journal of Quckett Microscopical Club*.—G. C. Karop.

Formaldehyde Generator.—This apparatus shown in the illustration has been designed by C. Truax, Green and Co., for the safe, convenient and economic production of formaldehyde by the oxydation of methyl alcohol.

□ Methyl alcohol is made from wood and is much preferred to sulphur for disinfecting purposes. It will penetrate bedding, furniture and clothing, thoroughly disinfecting them without discoloration.

This lamp is convenient, economical and simple in construction, compactly made and requires no fine manipulation to secure the desired result. A room having 2,500 cubic feet capacity may be thoroughly disinfected by

this generator without any previous preparation by one filling of the reservoir.

Formaldehyde in its gaseous form has the properties of ready diffusibility and great power of penetration. It may also be used in connection with a sterilizer constructed for the purpose of sterilizing surgical instruments and dressings.—*Journal of Am. Med. Association*.

A Polarizing Microscope.—Dr. F. C. Van Dyck of Rutgers College described in this Journal in May, 1895, a polarizing microscope which he was using for projection. He has been improving it since that time, till now the results are highly satisfactory. The lantern is a

vertical one, the rays being reflected horizontally by a right-angled prism at the top of the instrument.

Referring to the illustration published in the Journal of May 18, 1895 (p. 154) the general scheme of arrangement is shown. The alum cell is above the second large lens as shown, and the sub-stage condenser is also removed with the 7-8 objective. The analyser swings out from the optical axis, as does also a selenite placed where the sub-stage condenser is shown.

As for its performance, the field on the microscope stage is 1-4 inch; on the screen, 31 feet distant, it is shown just 8 feet in diameter, and as light as the average field of a calcium light stereopticon. With polarized light the structure of granite, pitchstone, Labradorite, and marble were distinctly shown, with the several minerals which were present in them.

The blue and yellow field obtained by using the selenite with open and crossed nicols gave the effects of polarization with much greater distinctness, and added greatly to the beauty of the slide. Some of the specimens so shown were chalcedony, salicine, asparagin, animal and vegetable sections. If a hair, or any dense tissue was present in the preparation, the exact location of such a part was very clearly shown by this combination of selenite and polarizer. Thus the stellate hairs of deutzia, the hairs in the nose of a cat, the cartilaginous portions of a cat's tongue, the difference in composition between the nail and the rhizoid processes forming the "quick;" were all shown far more clearly by this means than by normal light. The medullary rays in trans-sections of woody stems were also polarized, and indicated a beginning of a new field for the application of this light, heretofore regarded as the monopoly of the mineralogist and petrologist.

Dr. A. H. Chester has heartily co-operated with Dr. Van Dyck in his work, and they have used their instrument before the Brooklyn and New York Academies of Science recently and received much encouragement and hearty congratulations from other students of physical science.—
Frederick H. Blodgett.

MICROSCOPICAL MANIPULATION.

Formaldehyde.—Among the newer preparations formaldehyde appears to be meeting many of the claims made for it. It seems to have a wide field of usefulness in several directions: 1. As a food preservative; 2. As a deodorant either in vapor or solution; 3. As a hardening agent in microscopical work; 4. As a preservative of human cadavers; 5. A careful inspection has shown that disinfection by means of formaldehyde vapor is most thorough and complete.

Experiments prove conclusively that formaldehyde as a preservative for mucilage and paste is the *ne plus ultra*. Before however, this preparation can be used indiscriminately as a preservative for foods and liquors, its nontoxicity must be established beyond the shadow of a doubt. It would seem that this preparation covers a wider field as a preservative than either salicylic acid or borax, and the same care which has been used in testing the physiological effects of these, should be employed with formaldehyde.

Not long ago, when for present lack of time, several specimens of pathological urine could not be examined immediately by a physician, he added two drops of the 40 per cent solution of formaldehyde to each four ounce bottle of the specimens, which expedient answered admirably. Recent experiments in mounting tube-casts, using formaldehyde as a preservative, have proved its efficacy after five weeks. Still these experiments have not continued long enough to guarantee the permanency of the result.—
Western Druggist.

MEDICAL MICROSCOPY.

Yellow Fever. There seems no reason to doubt that Giuseppe Sanarelli has discovered the bacillus of yellow fever, as announced some weeks ago. Whether he has discovered a means of curing it, remains to be proved; but the experiment and the result will shortly be pub-

lished. At Monte Video it is believed that Dr. Sanarelli has succeeded, and it is believed that he will win the reward of about £30,000 offered by the Brazillian Government. It may be remembered that the enthusiastic Italian biologist cured himself of yellow fever caught in the course of his investigations.—Scientific American.

Diagnosis of Pregnancy with the Microscope.—Dr. Park, of Philadelphia, (Amer. Gyn. and Obstet. Jour.) reports that after a microscopic study of the triple phosphates in the urine of pregnant women, he is satisfied that they began to change their form within twenty days after conception. The feathery appearance first disappears from the tips of the crystals and progresses downward to the base.

Sometimes it occurs only on one side, but generally on both. If the foetus dies they resume their normal appearance again. The advantage of this means of diagnosis is that it can be made without the patient's suspecting the object of the examination, and at a much earlier period than any reliable physical sign can be obtained.

Fish Diet and Leprosy.—Dr. Hensen, of Bergen, says: "I do not think that there is any choice given to the bacteria of leprosy as to localization, just as there is none in the tubercle bacillus. They develop wherever chance has deposited them and wherever they find favoring conditions and no obstacles; for example, on the outside of the arm where there is little muscular movement. On the exposed portions of the body, oxygen retains and feeds them. The inoculation by insects can only be successful in these places; in others, circumstances are too much against them. An internal inoculation is also easily imaginable and even probable. Salt fish is eaten all over the world; raw fish is eaten only in some countries, like Japan. Fish, especially the carp, which is so general an alimentation in Japan, where it is eaten raw and even alive, feed on the larvæ of mosquitoes, and may be suspected of communicating the spores of disease extracted by the insects from the exposed parts of diseased bodies. If not, however, spores, then the toxins of the bacilli. In reflecting, then,

upon these points, I should be disposed to conclude that external leprosy inoculation means tubercular leprosy, and internal inoculation anesthetic leprosy."

Medico-legal Importance of the Excrements.—Prof. Moeller has an article in the *Wein. klin. Rundschau* of March 14 calling attention to the value of the testimony afforded in criminal proceedings by microscopic examination of the dejecta. He suggests that criminals arrested on suspicion should be interrogated as to what and where they had eaten recently, and the feces will confirm the truth of their assertions or the reverse, disprove an alibi, etc. He mentions two separate instances where the criminals were traced and brought to justice by casual discovery of fig seeds in their excreta, and adds that the microscope should be used more frequently than at present in criminal proceedings.

BACTERIOLOGY.

The Saliva a Microbe Killer.—It has long been known that secretions of the mucous membranes, especially saliva possess antiseptic properties under certain circumstances, which explains the reason why the germs which enter daily and hourly through the mouth do not reach a harmful development; but Edinger has now found the active material in potassium rhodanate, which is present in saliva. Potassium rhodanate is a compound of sulphur, cyanogen, and potassium, and is in large quantities, narcotically poisonous to warm blooded animals; it is, like other rhodanates fatal to bacilli. It is said that quinolin rhodanate, in a solution of three parts to the thousand, will kill the cholera bacillus in a minute, and in a solution of three times this strength, will kill the diphtheria bacillus in the same time. It was found by further researches that this rhodanate has the effect of carbolic acid and of corrosive sublimate, and at the same time is harmless to man.

Rhodanate is the same thing as sulpho-cyanate, a much better word because it explains itself, and is not liable to be confounded with the derivatives of rhodium.—*Popular Science News.*

Natural and Acquired Immunity.—The natural immunity of certain animals to certain diseases; even when the actual virus is injected, has long been known. Recently careful investigations have been carried out at the Pasteur Institute at Lille. In the experiments use was made of the following poisons; an animal virus, serpent's venom, and a vegetable poison (abrine) prepared by macerating jequirity seeds in water. They found that the immunity of pigs and hedgehogs to venom and of fowls and tortoises to abrine could not be due to the presence of antitoxins in the blood previously to inoculation, for the serum of the normal animals had no protective effect on susceptible animals, nor had it any neutralizing effect on the poison when mixed with it outside the body before inoculation, in both these respects differing from serum containing antitoxins. They were also unable to discover any antitoxic substance in the brain, liver, spleen, or other organs of the normal animals. They hold therefore, that the antitoxic serum is independent of immunity, since that may exist when no antitoxic properties are possessed by the serum. They attribute both kinds of immunity to special characters of the cells of the body.—Lancet.

Bartonology Technique of Obtaining Serum and Dried Blood.—Drs. Hermann Biggs and William H. Park give the following methods for collecting blood to diagnose typhoid fever by the Widal method. Blood may be easily obtained by pricking the tip of the finger or the ear. Two or three large drops should be collected on a glass slide and allowed to dry. Paper is not as good a receiver for the blood as glass, for the blood soaks more or less into it, and later, when it is dissolved, some of the paper fibre is apt to be rubbed off with it.

In preparing the specimen for examination the dried blood is brought into solution by mixing it with about five times the quantity of water. Then a drop of this decidedly reddish mixture is placed on a cover-glass and to it is added a drop of fifteen-to-twenty-hour bouillon culture of the typhoid bacillus. The two drops, after being mixed,

should have a faint reddish tinge. The cover-glass, with the mixture on the surface, is inverted over a hollow slide (the edges about the concavity having been smeared with oil or fluid vaseline so as to make a closed chamber), and the hanging drop then examined under the microscope (preferably by gas light), a high-power dry lens (about 1-6 inch) being used.

If the reaction takes place rapidly, the first glance through the microscope reveals the completed reaction, all the bacilli being in loose clumps and nearly or altogether motionless. Between the clumps are clear spaces containing few or no isolated bacilli.

If the reaction is a little less complete, a few bacilli may be found moving slowly between the clumps, in an aimless way, while others attached to the clumps by one end are apparently trying to pull away, much as a fly caught on a fly-paper struggles for freedom.

If the agglutinating substances are still less abundant, the reaction may be watched through the whole course of its development. Immediately after mixing the blood and culture together it will be noticed that many of the bacilli move more slowly than before the addition of the serum. Some of these soon cease all progressive movement and it will be seen that they are gathering together in small groups of two or more, the individual bacilli being still somewhat separated from each other. Gradually they close up the spaces between them and clumps are formed. According to the completeness of the reaction, either all the bacilli may finally become clumped and immobilized or only a small portion of them, the rest remaining freely motile, and even those clumped may appear to be struggling for freedom. With blood containing a large amount of the agglutinating substances all gradations in the intensity of the reaction may be observed, from those shown in a marked and immediate reaction to those appearing in a late and indefinite one, by simply varying the proportion of blood added to the culture fluid.

Pseudo Re-actions With Dried Blood. -If too concentrated a solution of dried blood from a healthy person

is employed, there will be an immobilization of the bacilli, but no true clumping. This is sometimes mistaken for a re-action. Again, dissolved blood always shows a varying amount of detritus, partly in the form of fibrinous clumps, and prolonged microscopical examination of the mixture of dissolved blood with a culture fluid shows that the bacilli often become entangled in these clumps, and in the course of one-half to one hour very few isolated motile bacteria are seen. The fibrinous clumps, especially if examined with a poor light, may be very easily mistaken for clumps of bacilli. This pseudo-re-action is regarded by many inexperienced observers as a true typhoid re-action, but it occurs as readily with non-typhoid as with typhoid blood.—*Prof. L. H. Pammel, Ames, Iowa.*

MICROSCOPICAL SOCIETIES.

New Jersey State Microscopical Society.

April 26.—The 28th Anniversary of this society was celebrated at New Brunswick, N. J., by the most successful soiree yet held. There were fifty-seven exhibits under microscopes and on tables, and a demonstration of rock sections by polarized light as a preliminary.—*F. H. Blodgett, Secretary.*

The American Microscopical Society.

The next meeting of the American Microscopical Society will be held at Toledo on Thursday, Friday and Saturday, August 5, 6 and 7. The Toledo Microscopical Society have very cordially invited their brethren from other parts of the country to pay them a visit and have promised to do all in their power to render that visit entertaining and instructive.

Those who attended the gathering at Pittsburg last year will recall the welcome tendered and the interest manifested by the members and their friends in the Iron City and we trust that all who can do so will renew the experience by coming to Toledo in 1897.

The officers for the Toledo meeting are as follows: President, Prof. E. W. Claypole, B. A., D. Sc. (Lond.) F. G. S., Buchtel College, Akron, O.; Vice-President, C. C. Mellor. Pittsburgh, Pa.; Secretary, William C. Krauss, M. D., Buffalo, N. Y.; Treasurer, Magnus Pflaum, Pittsburgh, Pa.; Executive Committee, A. A. Young, M. D., Newark, N. Y., Mrs. S. P. Gage, Ithaca, N. Y., W. P. Manton, M. D., Detroit, Mich.

The purpose for which the Society exists are the following:

1.—To give to all who are interested in the use of the Microscope an opportunity of seeing what others are doing and of showing to others what they are doing themselves. In this way time is saved by avoiding useless experiments and labor directed into profitable channels. Moreover workers are often enabled to give one another mutual assistance by becoming acquainted with the fields in which their fellows are engaged.

2.—To afford an opportunity for personal acquaintance and intercourse with other microscopists and thus lessen the sense of isolation which the great size of the country and the fewness of the workers inevitably produces. Acquaintances thus begun at the meetings often ripen into life-long friendships based on mutual esteem and appreciation.

3.—To afford to a Microscopist working under difficulties in a country district or in a small educational institution an opportunity of seeing the more costly and complicated pieces of apparatus only to be found in the hands of dealers, professors teaching in large or wealthy colleges or specialists in the great cities.

4.—To advance the cause of microscopic study among the people living in the district where the meeting is held by showing the interest felt in the work outside of their own limits. For this reason the Society assembles at a different place every year.

The American Microscopical Society is national in extent and welcomes to membership all who are sufficiently interested in actual microscopical work or in the results

of that work to enlist in its ranks. No other stipulation is made. It is a band of workers interested in each other's pursuits and willing to give and take whatever aid their union can supply. They do not set themselves on a pinnacle as experts and specialists but claim to be merely a small company working for the general good and well aware that the humblest observer may be able to add knowledge and experience that will be of value to all. The yearly subscription to the A. M. S. is two dollars with an entrance fee of three dollars. In return for that the members receive free a copy of the published papers of the Society.

Quekett Microscopical Club.—Mr. W. Stokes gave a description of some easily-made monochromatic light filters for microscopical purposes. The subject was further discussed by Mr. Nelson, Mr. Rheinberg, and others. Mr. T. Rosseter read a paper "Experimental Infection of the Domestic Duck with *Cysticerci* or Larval Tapeworms." Specimens and drawings were shown, by the author, of *Dicranotænia coronula* and *Cysticercus coronula*, *Drepanidotænia gracilis* and *Cysticercus gracilis*, *D. tenuirostris* and *Cysticercus tenuirostris*, in which cases he had proved by direct experiment that the given *Cysticerci* were really the larval forms of the tapeworms specified, and the matter was now no longer one of mere surmise from the identity of the hooklets, &c. The secretary said Mr. Rosseter appeared to be the sole investigator of the life history of this interesting group of bird parasites in this country.

Mr. Nelson exhibited a new triplet magnifier he had computed with a working distance of 8-10 in., a new achromatic and aplanatic bull's-eye, and read a paper on the secondary structure of the diatom, *Kittonia elaborata*.

In consequence of April 16th being Good Friday, the next ordinary meeting will be held on Friday, May 21st.

The College of Physicians and Surgeons, of Chicago, has recently become the Medical School of the University of Illinois.

1. German Carp.
(lateral).
2. Stickleback.
3. Bluefish.
4. Herring.
5. Sole.
6. English Sole.
7. English Sole.
8. English Sole.
9. Tom-cod.

10. Tom-cod.
11. Minnow.
12. Minnow.
13. Minnow.
(lateral).
14. Perch.
(lateral).
15. Cod (?).
16. Opal.
17. Opal.

SCALES OF FISHES.

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Notes on Some New, or Presumably New, Infusoria.

BY J. C. SMITH,

NEW ORLEANS, LA.

(Continued from Page 117 of last Month's Journal.)

Family.—Anisonemidæ. S. K.

Genus.—Entosiphon. Stien.

Species.—Entosiphon emarginata. (fig. 12.)

Body subobovate; less than twice as long as wide; anterior extremity slightly emarginate and flexed towards the ventrum; posterior extremity obtusely pointed; the right hand half of the anterior border slightly concave; dorsum convex and smooth; ventrum plane; oval aperture at apex of anterior emargination; pharyngeal tube extending in a median line from the oval aperture through two thirds of the body length; flagella originating together and to the right of the oval aperture; the anterior one equal to one body length and the posterior one to two body lengths; contractile vesicle conspicuous and located in the anterior half just below the dextral concavity; nucleus round and subcentral; endoplasm bluish and granular in posterior body half; locomotion as *Entosiphon sulcatus*. Duj. Size 1-1833 inch. Habitat—Pond water with algæ. Longitudinal fission.

This minute specimen of the genus resembles very much in outline the *Anisonema pusilla* of Dr. Stokes, but the resemblance goes no further. The pharyngeal tube is protusile and this is made very apparent when the

infusorian is pressing up against debris, in the act of feeding. The movement of the body during natation is the same smooth even glide of the genus. This form has been found quite abundant at times and but once has reproduction been observed—the process occupying about one hour.

Family.—Enchelyidæ. S. K.

Genus.—Enchelys. Ehr.

Species.—Enchelys audobonii. (fig. 13.)

Body obovate, the anterior border produced in a snout-like manner, subcylindrical, soft and changeable in shape more than twice as long as wide; entirely and sparingly ciliate; oral aperture apical, cleft-like and continued medially for about one-sixth of the body length, as a conspicuous, non-plicate, wedge-shaped membranous pharynx; oral cilia much longer, heavier and more numerous than the body cilia; a single hair-like seta extending from the posterior border as long as one-half the body length; contractile vesicle round, conspicuous and located in posterior third, nucleus round and subcentral; endoplasm granular and of a greenish tint, usually containing food balls. Reproduction by transverse fission; conjugation by the application of the oral apertures. Locomotion rapid and by revolution on long axis. Size 1-600 to 1-460 inch. Habitat—Pond water with decayed leaves from Audobon Park, New Orleans, La.

This infusorian was found in great abundance a number of times in pond water taken from Audobon Park. While the most persistent shape is obovate it is, like *Enchelys farcimen* Ehr., subject to many changes of form from an ovate to almost globular. The oral aperture forms the base of the wedge-shape pharynx and is persistently open. It is a greedy scavenger. The writer has a number of times observed a dozen or more surrounding some dead form ravenously devouring it. The elas-

ticity and capaciousness of the oral aperture and pharynx has been often demonstrated by the engulfing of particles of food twice the size of the infusorian. The caudal seta is difficult to see excepting when the infusorian is quiet.

Family.—Prorodontidæ. S. K.

Genus.—Holophrya. Ehr.

Species.—Holophrya pogonias. (fig. 14.)

Body ovate, subcylindrical, exceedingly elastic and changeable in shape; twice as long as wide; posterior evenly rounded, anterior transversely truncate and including oval aperture; body entirely and finely ciliate; coarsely striated longitudinally; oral and body cilia not diverse; a supplementary fascicle of extra-oral cilia situated just below the oral aperture; these cilia much heavier (not setose) and about three times longer than the body cilia; projecting upwards and some distance above the oral aperture; contractile vesicle round, conspicuous and centrally located; nucleus botuliform and placed longitudinally alongside the contractile vesicle; endoplasm granular, of a yellowish tint and usually containing large food balls; locomotion in a wabbling manner by revolution on long axis. Size 1-150 inch. Habitat—Brackish water from Lake Pontchartrain.

The writer has some doubts as to the position of this form and has placed it among the Prorodontidæ provisionally. In its habits and general appearance it resembles the Holophrya, but the presence of the extra-oral cilia may prevent its being placed among this family.

Family.—Colpidæ. Ehr.

Genus.—Coleps. Stien.

Species.—Coleps striata. (fig. 15.)

Body subovate, cylindrical, slightly elastic but persistent in shape; less than twice as long as wide; anterior

transversely truncate and including oral aperture; posterior evenly rounded; heavily striate longitudinally; the spaces intervening finely and closely striate transversely oral cilia longer than body cilia, but not setose; contractile vesicle large and postero-terminal; nucleus roundish and sub-central; oval aperture to one side and just above the contractile vesicle; endoplasm granular; locomotion even and by revolution on long axis. Size 1-500 inch. Habitat—Fountain water with aquatic plants.

This form would, if it possessed the setose oral cilia, certainly be classed as a *Plagiapogon*-Ehrenberg. The very heavy longitudinal striation, which are almost band like in this new form, and the fine transverse striation of the intervening spaces are also characteristic of the genus *Plagiapogon*. In its habits it is the same scavenger that the *Coleps hirtus* is.

Family.—Lembidæ. S. K.

Genus.—*Lembus*. Colin.

Species.—*Lembus attenuata*. (fig. 16.)

Body elongate, subcylindrical; elastic but persistent in shape: about six times as long as widest part; widest at the center and tapering to both extremities; anterior transversely truncate; posterior ending in a sharp point, an undulating membrane and a furrow commencing just behind the anterior border and extending backward to the oral aperture, which is situated at the junction of the first and second body fourths; body sparingly clothed with cilia and these cilia as long as the widest central part of the body; oral cilia same size as body cilia but more numerous; undulating membrane capacious and extending as far out as distal ends of oral cilia; contractile vesicle conspicuous and situated centrally near the ventrum; endoplasm bluish and semi-opaque, locomotion vermicular.

Size 1-325 inch. Habitat—Stale pond water.

So far as the writer knows this is the first fresh-water member of the family recorded.

Family.—Dysteriidæ. S. K.

Genus.—Trochilia, Dujardin.

Species.—Trochilia fluviatilis. (fig. 17.)

Body subelliptical; almost twice as long as wide; carapace single, dorsum broadly convex; anterior obliquely truncate to ventrum, posterior rounded; ventrum plane and clothed with fine short cilia; a movable stylete appendage originating in the posterior third of the ventrum and projecting to a short distance beyond the posterior border; projecting from, and within the anterior truncation, are numerous fine vibratile cilia; this truncation also includes the oral aperture and proceeding backward from this aperture is a tubular pharynx which continues directly upwards, through three fourths of the body length; this pharynx is protusile; contractile vesicles, three, two located in the anterior body half, above the pharynx and near the dorsum and one in the posterior body half below the pharynx and near the ventrum; nucleus not observed,—obscure; endoplasm, bluish and very often vacuolar, size 1-850 inch. Habitat, Pond water with aquatic plants, ponds connected with the Mississippi river.

For one month the writer got a number of dips from a pond in Audobon Park, New Orleans, and in almost every one of the numerous examinations made of this water, were found an abundance of this form. They move about and through debris piles very much as an Aspidisca. In no single instance, when they were examined closely and measured, was there the slightest difference in shape or size. While the truncated anterior was pressed against a heap the tubular pharynx could be seen distinctly to move forwards, as is observed in the case of Entosiphon sulcatus, Duj. Unfortunately the

nucleus could not be observed even after the most careful search and the application of the usual reagents. In some samples examined all the forms under the cover glass were densely vacuolated.

Family.—Onytrichidæ. S. K.

Genus.—Stichotricha. Perty.

Species.—Stichotricha opisthotonoides. (fig. 18.)

Body elongate; somewhat club shaped, the anterior two thirds attenuate, three times as long as the widest part; highly elastic but persistent in shape; addicted to curving backwards; peristome channel-like and extending from the apex to the posterior body third and there curved towards the left hand body border, the peristome cilia long and heavy diminishing in size as they approach the oral aperture; the left hand border of the peristome finely ciliated and bearing a conspicuous undulating membrane, marginal setæ on the anterior half of the sinistral border and on the posterior border; two oblique rows of small ventral setæ extending from the sinistral to posterior setæ; contractile vesicle conspicuous, located in the posterior third and in contact with the left hand border which it extends at each expansion; nucleus, two, ovate and situated one in each body half; locomotion eccentric. Size 1-450 inch.

Habitat—Old infusion of aquatic plants in ditch water.

The writer had under observation quite a large number of this new form and they were all addicted to the habit of bending the anterior attenuate body half backwards as if in great pain; it was this peculiar habit that suggested its specific name. While in this act the undulating membrane is thrown out from the body border to a considerable distance. The writer has never seen recorded that any of this genus possessed an undulating membrane and believes this species stands alone in this

respect. The *Stichotricha secunda*—Perty, and *Stichotricha aculeata*—Wrz, are often seen in the pond waters in New Orleans and bear only a superficial resemblance to this form.

Family.—Oxytrichidæ. S. K.

Genus.—Oxytricha. Ehr.

Species.—Oxytricha furcatus. (fig. 19.)

Body elliptical, both extremities evenly rounded; very



5



- 12.—Entosiphon emarginata. x 1500.
- 13.—Enchelys audoboni. x 500.
- 14. Holophrys pogonias. x 150.
- 15.—Coleps striata. x 375.
- 16.—Lembus attenuata. x 730.
- 17.—Trochilia fluviatilis. x 740.
- 18.—Stichotricha opisthotonoides x 675.
- 19.—Oxytricha furcatus. x 225.

soft and flexible, less than two and a half times as long as wide; the left hand border slightly concave anteriorly lip crescentic and conspicuous; peristome extending to centre of body and strongly curved to oral aperture; the right hand border of peristome bearing an undulating membrane; frontal styles, eight and arranged as on *Stytonychia mytilus*, Ehr.; the three most anterior uncinata, and the remaining five furcated; ventral series arranged as on *Stytonychia mytilus*, Ehr., and all furcated; anal

styles, five, fimbriated at their distal ends and all, but the one nearest the left hand body border; projecting beyond the posterior marginal setæ continuous, heavier and longer posteriorly; contractile vesicle located at the centre of the left hand body border; nucleus, two, elongate, one in each body half. Size from 1-200 to 1-150 inch. Habitat—Old infusion of rose fission petals. Transverse.

This form was found exceedingly abundant in an old infusion of rose petals, feeding ravenously on the very abundant bacteria. Many of them seemed so gorged with food that they moved about very lazily, affording the writer a good opportunity for their observation. The fine inferior frontal styles and all of the ventral series were invariably furcated to within almost their origin; bifurcated usually, a few specimens distinctly tri-furcated. In a few specimens the three superior of the frontal series were bifurcated and in some rare instances an odd one or two of the marginal series were bifurcated. The distal ends of all of the anal series, for about one fifth of their length, were distinctly and uniformly fimbriated.

SUPPLEMENTARY NOTE UPON ACTINOMONAS PRIMUS.

An infusorian somewhat similar to this form is described by Dr. Gruber under the title of *Dimorpha mutans*.* In its flagellate condition, the *D. mutans* resembles a *Heteromita*, having an anterior vibratile and a posterior trailing flagella. In its Heliozoan state the pseudopodal rays equal from two to three diameters of the zooid and decussate.

ERRATA: Wherever the word "Ventrum" appears read "Ventral Surface."

In family Anisomidæ, Species *Diplomastix rostrum*, read "rostratus" for rostrum.

In family Anisomidæ, Specie *Entosiphon emarginata*, reverse the figure, making the right hand border the left hand. Contractile Vesicle following the change; the figure should be turned over. In the diagnosis of this Species where the word right or dextral appears read "left" or "Sinistral."

*Appendix to vol. II Kent's Manual of the Infusoria.

Preparation of Culture Media with Special Reference to Sterilization.

BY RAYMOND C. REED, Ph. B.

[Assistant in the Department of Comparative Pathology and Bacteriology, New York State Veterinary College, Cornell University, Ithaca, N. Y.]

The amount of culture media used by the students in a bacteriological laboratory is so great that its preparation after the method given in the text books occupies an undue proportion of the time allotted to this subject. If it is prepared by an assistant and furnished to the students it not only takes much of his time, but it deprives the student of the opportunity of learning one of the most important processes necessary for successful work in bacteriology. Hence any change which will shorten the time required for its preparation will be of value. When it is prepared by the usual method recommended in text books on Bacteriology at least three days are necessary to complete the process of sterilization. The method of sterilizing by which the media is heated to a somewhat higher temperature than 100° C. by means of superheated steam is open to the objection that the nutritive properties are impaired to a greater or less extent for certain species of bacteria.

In 1890 Moore* published a paper giving the method employed in the Bureau of Animal Industry for making nutritive agar and which seems to be the one recommended, with slight variations as to details, in the greater number of bacteriologies. The two most important changes suggested were, (1) that when the agar was made from meat infusion instead of meat extract, it should be prepared from bouillon which could be made up in quantities and kept stored in flasks as stock ready for use. This applies not only to the making of agar but also gelatin

*The Preparation of Nutritive Agar. By V. A. Moore, M. D., American Microscopical Journal, May, 1890.

or any other medium which requires a meat infusion for its nutritive base. (2) That the agar should be cut up in small pieces and dissolved in a liquid which contains no coagulable material before it is added to the bouillon. This is done by using the proportion of five grams of agar, finely chopped, to 100 c. c. of water and boiling in an agate iron dish over a direct flame with constant stirring. I have found, however, that it is more satisfactory to boil the agar in a closed water bath. This takes not to exceed twenty minutes longer and as there is no danger of the agar burning the stirring and constant attention required when it is dissolved over a flame is unnecessary. By this method the agar is completely dissolved and a medium of a known consistency can always be made.

In 1892 Schultz,* of the Johns Hopkins Hospital, described a rapid method of making agar which requires but one hour for the whole process. For this he uses meat extract which gives a medium favorable for the growth of some organisms but not for others. He also gives a method by which the agar may be made from meat infusion taking but an hour and a half.

The following method of preparing media has proved very satisfactory and in my hands more so than the one described by Schultz although his process has many advantages.

The preparation of peptonized bouillon.—To 1000 grams of finely chopped or ground meat (beef or veal) add 2000 c. c. of distilled water. Put in an agate iron dish and heat in a water bath at a temperature of from 60° to 65° C for two hours or allow it to macerate in a cool place for 24 hours. Strain through a coarse cloth and bring the amount of liquid up to 2000 c. c. by adding water if necessary. To this infusion add $\frac{1}{2}$ per cent peptone and

*A Rapid Method of Making Agar-agar. By John L. Schultz. John's Hopkins Hospital Bulletin, No. 24, July—Aug., 1892.

† per cent sodium chloride and if a neutral or alkaline medium is desired add enough of a 1 per cent solution of caustic soda to bring about the required reaction. Boil in a water bath for half an hour. Cool and filter through ordinary filter paper and distribute in sterilized flasks. The amount in each flask is to be determined by the work in the laboratory. I have found 500 c. c. a convenient quantity.

Preparation of nutrient agar.—Dissolve 5 grams of finely cut agar in about 100 c. c. of water. This may be done in either of two ways, by heating over a direct flame for about ten minutes with constant stirring to prevent burning or by heating in a closed water bath until the whole mass becomes gelatinous. The agar is then added to 500 c. c. of bouillon, thoroughly mixed with it and boiled in a water bath for twenty minutes. It is then cooled down to 45° to 50° C. and the whites of two eggs added and thoroughly mixed with the agar. It is then returned to the water bath and boiled for from twenty to thirty minutes. The albumen will then be collected in a firm coagulum containing any insoluble particles that may have been in the agar, leaving a perfectly clear liquid. It is filtered while hot through ordinary filter paper, the filtration taking place rapidly without the aid of a hot filtering apparatus. The filtrate is then distributed in tubes which have been previously plugged with absorbent cotton and sterilized.

Preparation of nutrient gelatin.—To 500 c. c. of bouillon add 50 grams of gelatin and heat in a water bath until the gelatin is dissolved. Cool to about 45° C. and add the whites of two eggs, mix thoroughly. This is done most rapidly and effectually by pouring the liquid several times from one dish to another. Then boil in a water bath for twenty minutes. Filter through ordinary filter paper and distribute in sterilized tubes. Care

must be taken not to boil gelatin too long or it will lose its property of solidifying when cold.

Sterilization of Media. It will be seen that the process of preparing culture media up to the point of sterilization is practically the same as that described in recent text books on bacteriology. The method is short and by having the nutritive medium prepared and kept in stock the preparation up to this point of either agar or gelatin is very simple. The essential time consuming part of the process is the sterilization. Although this has now been reduced from the boiling on six consecutive days to three, it is still an important element in laboratory work especially where students are present but two or three days, usually alternating, in each week.

During the past two terms I have made a considerable number of experiments for the purpose of determining if it is necessary in order to secure complete sterilization to boil media, when distributed in small quantities in tubes, for three consecutive days. In these experiments I have found that one boiling for a slightly longer time, thirty minutes, seems to be all that is necessary to sterilize bouillon, nutrient agar and nutrient gelatin distributed in either small or large tubes. After distributing the medium the tubes were put in a closed water bath and boiled vigorously for thirty minutes. At the expiration of that time they were taken out and placed in an incubator where they were allowed to remain for several days, when it was a simple matter to sort out and reject any tubes that may have been contaminated. As will be seen from the appended tables, giving the results of these experiments, contaminations have been very rare. In fact they have not been much if any more numerous than they were when the three regular boilings were employed. Although several of the agar and gelatin tubes were not sterilized, they were contaminated with a spore

bearing bacillus which has not infrequently appeared in media boiled for ten minutes on three consecutive days.

STERILIZATION OF BOUILLON WITH ONE BOILING.

Date.	Number of tubes.	Amount in each tube.	Time boiled.	Days in incubator after boiling.	No. of tubes contaminated.	Remarks
Jan. 9, 1897	40	7 c. c.....	30 min.....	7	0	.....
Jan. 14, 1897	80	7 c. c.	30 min.....	7	0	.....
Jan. 14, 1897	14	25 c. c.....	30 min.....	7	0	Fermentation tubes with one per cent. glucose.
Feb. 5, 1897	32	7 c. c.....	30 min.....	7	0	.....
Feb. 11, 1897	35	7 c. c.	30 min.....	6	0	.....
Mar. 5, 1897	46	7 c. c.....	30 min.....	7	0	.....
Apr. 6, 1897	45	7 c. c.	30 min.....	5	0	.....

STERILIZATION OF AGAR WITH ONE BOILING.

Date.	Number of tubes.	Amount in each tube.	Time boiled.	Days in incubator after boiling.	No of tubes contaminated.	Remarks.
Jan. 22, 1897	50	7 c. c.	30 min.....	7	3	Each of the three tubes contained a spore bearing bacillus belonging to the <i>B. subtilis</i> group.
Jan. 27, 1897	48	7 c. c.	30 min.....	7	2	Same as above.
Feb. 5, 1897	81	7 c. c.....	30 min.....	6	0	.....
Feb 13, 1897	14	7 c. c.....	30 min.....	7	0	.....
Mar. 16, 1897	25	7 c. c.....	30 min.....	7	0	.....
Mar. 27, 1897	41	7 c. c.....	30 min.....	7	0	.....
Apr. 6, 1897	40	7 c. c.....	30 min.....	7	0	.....

STERILIZATION OF TUBES OF AGAR CONTAINING A LARGER QUANTITY FOR MAKING PLATE CULTURES.

Date.	Number of tubes.	Amount in each tube.	Time boiled.	Days in incubator after boiling.	No. of tubes contaminated.	Remarks.
Dec. 29, 1896	30	12 c. c.	30 min.....		0	Left at room temp. for 10 days
Jan. 27, 1897	26	15 c. c.....	30 min.....	7	0	.....
Feb. 5, 1897	15	15 c. c.....	40 min.....	6	0	.....
Mar. 16, 1897	35	18 c. c.....	30 min....	7	0	.....
Mar. 27, 1897	43	18 c. c.	30 min.....	7	3	Spore bearing bacillus belonging to the <i>B. subtilis</i> group.
Apr. 6, 1897	40	18 c. c.....	30 min....	7		.....

STERILIZATION OF GELATIN WITH ONE BOILING.

Date.	Number of tubes.	Amount in each tube.	Time boiled.	Days in incubator after boiling	No. of tubes contaminated.	Remarks.
Dec. 29, 1896	30	12 c. c.....	30 min....		0	Left at room temp. for 14 days
Feb. 19, 1897	30	15 c. c.....	30 min....	7	0	.....
Mar. 18, 1897	15	18 c. c.....	30 min....	7	0	.....
Do.....	25	7 c. c.....	30 min....	7	1	Contained a spore bearing bacillus belonging to the <i>B. subtilis</i> group.
Mar. 23, 1897	10	18 c. c.....	30 min....	7	0	.....
Do.....	36	7 c. c.....	30 min....	7	0	.....
Mar. 25, 1897	35	7 c. c.....	30 min....	7	0	.....

If spore bearing bacilli are present in large numbers more difficulties might be experienced. But ordinarily if the medium is prepared with proper care and distributed as soon as filtered, in sterile tubes and boiled at once very few contaminations are likely to occur.

The time that must elapse before the medium can be safely used is not so much shorter than when the customary method is employed but the time actually spent in sterilizing is much shorter. In a crowded laboratory this is important. It probably is not necessary to leave the media in the incubator from five to seven days as I have indicated in the above tables for in every case of contamination the growth took place within the first twenty four hours.

I am not prepared to say that this method is the best or that it is safe for all kinds of work, but it has proved to be well adapted to the needs in a student laboratory and to save much valuable time for both the student and the teacher.

Prof. Hankine, one of the leaders in sanitary work in India, contracted plague a few weeks ago, but fortunately the attack was not severe and he recovered. He was inoculated with Haffkine's serum.

The Index of Refraction.

BY DR. B. L. RAWLINS,

• DALLAS, TEXAS.

A ready, fairly accurate and practical method of determining the index of refraction of liquids, and transparent solids with plane parallel sides, would be of interest possibly to the majority of workers.

The works on optics and the elementary treatises on how to work with the microscope, apparently lose sight of the necessity for something practical, in giving us complicated formulas and describing expensive instruments for determining this index.

It is with this apology that the writer offers this article, feeling sure that the same thing must have occurred to many, although he has never seen this method published.

As in passing from a rarer to a denser medium, a ray of light is deflected in a definite direction from its immergent course, likewise is the apparent distance through the denser medium less than the real distance.

As the ratio of the sin. of the angle of incidence to the sin. of the angle of refraction is constant, likewise is the ratio of the apparent distance through the denser medium to its real distance invariable.

From experiment it is found that as many times greater than the sin. of the angle of refraction is the sin. of the angle of incidence, so many times greater is the real distance through the denser medium, than the apparent distance.

For example the angle of refraction of water is 1.333: the apparent depth of a volume of water one and one-third feet in actual depth, is one foot.

Assuming that the worker interested in this subject is possessed of a microscope with accurate adjustment and a graduated micro-millimeter fine adjustment screw, he

needs but a slide with a flat cell cemented on it, and a plate cover glass in order to do the work. Perhaps the most convenient thing is the slide that goes with the Zeiss-Thoma blood counter. This has a circular cell cemented onto the slip, with a central cross lined disc, which forms an elevated platform in the centre of the cell, leaving a groove to catch any excess of liquid, in order that it may not flow between the top of the cell and cover glass.

In making the examination, the rules accompanying this instrument must be strictly regarded, in order to insure direct contact with the cover and top of cell. That is, when a minute drop has been placed on the platform and covered with the accompanying plate glass cover, the newtonian rings must appear, otherwise a bit of dust or something has prevented perfect contact between cell and cover. The depth of the cell in this instrument is convenient for calculations, as it is exactly 10 microns.

Procedure. Dust carefully the cell and cover glass with a soft lens brush. After putting the slip on the stage of the microscope (under a 1-5 or D objective for convenience in accurate focussing) the cover is put in place with a pair of forceps, pressed down centrally with the ball of the finger. The finger print made is of the greatest use. If the Newtonian rings are apparent, all is well; if not, try again. Turning the zero mark on the m. m. fine adjustment screw to the pointer, focus to the top of cover glass with coarse adjustment. A little patience allows one to do this, and it is much more convenient. This done, focus with the fine adjustment, noting the distance on the m. m. scale, until the top of the cross lines of the counter are in perfect focus. This distance represents the depth of cell, plus cover glass equal m. Removing the cover and pressing between the fingers, focussing on top and on bottom gives apparent (which is all required,) thickness of cover equal n.

The difference, m minus n equals a and equals depth of cell filled with air.

In like manner a drop of the liquid whose index of refraction is to be determined, is placed in the cell and the cover applied as before and pressed down with the finger. Let us suppose it is water, and that the equation for air substituted is 30 microns minus 20 microns equal 10 microns, or the depth of the cell filled with air. A equals 10 microns.

Now, m minus n equals b and equals depth of cell filled with water. Substituted we have 27.5 microns minus 7.5 microns. B equals 7.5 microns. A divided by b equals 10 divided by 7.5 which equals 1.333 the index of refraction of water.

For obtaining the index of transparent solids with plain sides, as for instance of cover glasses or slips, the apparent depth is obtained as before, the real thickness measured with the cover glass guage or calipers. Their ratio is the index.

It is not within the province of this article to suggest the important or varied applications attendant on the determination of this index, but the writer will feel highly repaid if it is of interest to any of the readers of the Journal.

EDITORIAL.

Prof. Edson S. Bastin.—The death of Prof. Edson S. Bastin means a severe loss to the body of American scientists. He was one of the most faithful workers in pharmacy. For the last two years he has devoted himself so unceasingly to microscopical work outside of the hours devoted to instruction, that he has virtually allowed himself no proper time for rest, and as a matter of fact, has almost worked himself to death. His work on the anatomy of plants of the pine family has been recognized as of great importance here and abroad.

Inks.—Dr. Marpmann of Leipzig, has recently published the results of the microscopical examination of 67 samples of ink used in schools. Most of these inks were made with gall-nuts, and contained saprophytes, bacteria and micrococci. Nigrosin ink, taken from a freshly opened bottle, was found to contain both saprophytes and bacteria. Red and blue inks also yielded numerous bacteria. In two instances Dr. Marpmann succeeded in cultivating from nigrosin ink a bacillus which proved fatal to mice within four days. This ink had stood in an open bottle for three months, and the inference drawn from the inquiry is that ink used in schools should be kept covered when not in use.

A Water Microbe.—One of the unaccountable phenomena of the Black Sea has been explained by the bacteriologists. Since time out of memory it has been a well-known fact that there were no deep-sea fish in the body of water mentioned. Away back in 1850 the scientists made an investigation and found that fish could not live at a greater depth than 200 fathoms in the water of the Black Sea on account of the presence of a superabundance of sulphuretted hydrogen. Time and again the waters were stocked with deep sea fish, but all died on account of the poisonous gas which was generated in such quantities in those portions of the water which should have been their natural habitat. It was known that the gas was at the bottom of all the trouble, but exactly where the gas came from was what so puzzled the investigators. The microbiologists finally took the matter in hand and a recent observer now announces that the gas is generated by the countless number of microbes which make their home in the ooze at the bottom. This microbe decomposes mineral sulphates and has been named *Bacillus hydrosulfuricus ponticus*.

One more indictment is added to the many against the house-fly. Yersin communicated plague to guinea-pigs by the inoculation of sterilized water in which flies found dead in the laboratory had been rubbed up.

MICROSCOPICAL MANIPULATION.

A New Culture Medium for the Diphtheria Bacillus.—Joos (Jour. Med. de Bruxelles, May 7, 1896) has had occasion to make a large number of bacteriological examinations in cases of suspected diphtheria. He finds that the ordinary methods of cultivating Löffler's bacillus are not satisfactory; he also finds Deycke's method unsatisfactory, as it hinders the growth of the Löffler bacillus, and stunts the colonies. Joos has modified Deycke's medium, and claims to have found a material on which no other bacillus except that of diphtheria will grow normally. He prepares "albuminate of soda" by adding saturated caustic soda solution to serum of strong alkalinity, placing the mixture in a vapor bath for half an hour, and filtering. To the filtrate is added pure hydrochloric acid till the reaction is neutral or very slightly alkaline. If too much caustic soda was not added at first, the substance is now ready for use; otherwise the excess of sodium chlorid requires to be dialyzed out. On evaporating to dryness, a powder is obtained which is readily soluble in water, and which is not coagulated by heat. The nutritive medium is prepared by adding to 1000 gr. of peptonized bouillon 20 gr. each of agar and "albuminate of soda." The mixture is placed in the autoclave at a temperature of 115 degrees to 120 degrees C. for half an hour; then 15 c.cm. of caustic soda are added, and the whole put back in the autoclave for fifteen minutes, after which it is filtered in the vapor bath. After filtration, it is sterilized at 120 degrees C. in the autoclave for three quarters of an hour, when it is ready for the preparation of the plates. It is claimed by Joos that streptococci will not grow on this medium at all, and staphylococci but feebly, while Löffler's bacillus grows luxuriantly in from six to twelve hours. If the presence of streptococci is to be determined as well, the amount of "albuminate" is to be reduced to one and one-half per cent. At the end of fifteen to eighteen hours small colonies of streptococci may be seen among the large and well-developed patches produced by the diphtheria bacillus.

Preservation of Urinary Deposits.—Heretofore the subject of mounting and preserving urinary deposits has received comparatively little attention, perhaps from the fact that no suitable method has been discovered. Specimens of urinary deposits, when properly mounted, are an excellent means of demonstrating the various pathological elements found in urine. We are indebted to Gumprecht (*Centralblatt f. Inn. Med.*; *British Medical Journal*, September, 1896) for the following method, which he finds to be superior to chloroform or glycerin: A deposit is first obtained by means of the centrifuge. This deposit is then placed in a concentrated solution of corrosive sublimate and centrifugalized again. It is then washed, and preserved in a solution of formal. The hardening in sublimate may be omitted if no red blood-cells are present. If there is much albumin present, the deposit may be washed with advantage in a normal saline solution. If the urine contains urates, the deposit should be washed with warm water or a concentrated boracic solution. The washing of a deposit by means of the centrifugal machine has long been in use in the laboratory. No washing is necessary if sublimate is not used. The strength of the formal solution may vary from two to ten per cent. The author says that urinary deposits thus preserved can hardly be distinguished from fresh deposits. Cover-glass preparations may be made, but it is well to wash off the formal. The cells maintain their shape, and the nuclei of the cells take the stain in the usual way. Casts, and especially red blood-cells, are well preserved. Fat is readily distinguished. Micro-organisms are easily recognized even when unstained.—*Modern Medicine.*

BACTERIOLOGY.

Virulent Diphtheria Bacillus of the Conjunctival Sac.—

Spronck (*Deutsche Med. Woch.*, 1896, No. 36) undertook to learn, by means of the specific protective property of Behring's serum, whether the diphtheria bacillus and

those slightly virulent or non-virulent bacilli which resemble it are the same species of bacterium. Out of seven cultures from the pharynx, there were five which produced a local edema and general disturbance in the guinea-pig when injected subcutaneously. Guinea-pigs which had been injected with a relatively large dose of anti-diphtheritic serum were not rendered immune to the effects of these cultures but the same dose of virulent diphtheria culture was without effect.

He also experimented with three cultures of the bacillus, resembling the diphtheria bacillus, isolated from typical cases of xerosis conjunctivæ. Subcutaneous injections, in guinea-pigs of medium size, of one to three cubic centimeters of a 24-hours bouillon culture, produced edematous swellings which disappeared after forty-eight hours, with loss of appetite, weakness, etc. Guinea-pigs which were rendered in a high degree immune to the diphtheria bacillus showed no increased resistance to the bacillus of xerosis.

The author concludes that the anti-diphtheritic serum is useful in differentiating the diphtheria bacillus from the slightly virulent xerosis bacillus. He thinks the results with the anti-diphtheritic serum leave no doubt that the xerosis bacillus does not belong to the true species of diphtheria bacilli but should be classed with one or more distinct varieties of bacilli.

He does not claim to settle the question as to whether every bacillus which loses its effects in the presence of the protective property of the anti-diphtheritic serum is the true diphtheria bacillus, but leaves it to further research.

Whether the diphtheria bacillus with slight virulence is a common inhabitant of the conjunctival sac, he thinks can be easily determined if all or most of the cultures possess sufficient virulence to allow of control investigations. He believes, however, that most of such are organisms which belong in the class of xerosis bacilli. He does not deny that the true diphtheria bacillus may be found in the con-

junctiva in specific diphtheria and other infections and in the normal conjunctiva on rare occasions.—Medicine.

On the Xerosis Bacillus.—J. Eyre (Journal of Pathology and Bacteriology, July, 1896) gives a report of interesting studies upon the bacillus of xerosis conjunctivæ. Twelve cases were examined, six being in males and six in females. Of the females, two were classmates and the remaining four were members of one family—an interval of about a week was noted between the onset of the attack in the mother and the three children. The cases were characterized clinically by a number of small, irregularly oval-shaped, pinkish, edematous bodies, situated in the lower conjunctival fornix, and not encroaching upon the ocular conjunctiva. Injection of the conjunctival vessels, lachrymation, photophobia, inability to continue at work requiring close observation, distress at night and when using artificial light, were among the symptoms.

In contrast to these cases he reports a case of true conjunctival diphtheria. The patient was a boy aged four years. Both eyes were affected, the lids being painful, red, and swollen, and separable with difficulty owing to the brawny infiltration of the subcutaneous tissue. The ocular conjunctiva was chemosed; the palpebral portion congested and thickened, presenting patches of a pale grayish-yellow membrane, which stripped off easily, leaving a raw bleeding surface.

The differences between the xerosis bacillus and the diphtheria bacillus are given as follows:

1. After inoculation of the secretion upon blood-serum, colonies of the xerosis bacillus do not appear within thirty-six hours; those of the diphtheria bacillus appear in sixteen to eighteen hours.

2. When grown in neutral bouillon or milk, the xerosis bacillus never gives rise to an acid reaction; the diphtheria bacillus invariably does.

3. When grown upon potato, the xerosis bacillus rapidly degenerates and dies; the diphtheria bacillus grows with more vigor and to a greater size than on any other medium.

4. When grown upon 10 per cent gelatin, colonies of the xerosis bacillus are not visible to the naked eye within forty-eight hours; the colonies of diphtheria bacilli can be recognized in twelve to twenty-four hours.

5. The invariably innocuous nature of the bouillon cultures of the xerosis bacillus, when inoculated into the subcutaneous tissues of animals is susceptible to the bacillus of diphtheria.

As to the exact nature of the xerosis bacillus—whether it be a non-virulent and slightly altered species of the bacillus diphtheriæ, or a totally separate and distinct bacillus—it is impossible at present to decide.

Leucocytes and the Bactericidal Action of the Blood.—Hahn (Arch. f. Hyg., vol. xxv, p. 105) has investigated the action of blood serum and also the pleural exudation of rabbits. The leucocytes in the latter are destroyed by freezing. He found that the exudate had a more powerful bactericidal action upon *Staphylococcus pyogenes aureus* and bacillus typhosis than the blood serum or the defribinated blood of the same animal; and since the leucocytes were destroyed, the action cannot depend upon phagocytosis in Metchnikoff's sense of the term. The author made experiments with Lichenfeld's histin-blood, in which the leucocytes remained unaffected, in order to determine whether the bactericidal power depends upon the destruction of leucocytes or upon substances secreted by the leucocytes while still alive. He came to the conclusion that the latter is the more probable explanation.

Bubonic Plague Bacillus.—Dr. Alvah H. Doty gives a full account of the history and germ of the bubonic plague. In the year 542 Egypt was considered the home of the plague. Between 660 and 680 England was invaded. In 1334 it was brought from the East, where it was supposed to have had its origin. Sicily 1346, Norway 1351. The mortality was enormous. During the eighteenth century the plague existed only in Eastern Europe, Asia and Africa. A slight outbreak occurred in Delmatia in 1840, and a severe one on the Volga, in the province of Astrakan in Russia, 1878-79.

Since then it has not appeared in Europe. In 1894 it occurred in Hong Kong and Canton; in the latter place 180,000 people died.

The credit of discovering this organism is due to Yersin and Kitasato, who worked independently in their investigations. The organism is known as *bacillus pestis bubonica*. It is found in large numbers in the buboes characteristic of this disease, in the lymphatic glands and occasionally in the internal organs. It occurs in the blood only in acute hæmorrhagic types, shortly before death.

The organism has been cultivated in artificial media and disease resembling it has been produced in lower animals. It is pathogenic to many animals and during epidemics rats, mice and flies die in large numbers, the disease being apparently transmitted through them.

It is a short and thick bacillus, somewhat motile, with rounded ends, somewhat motile, and stains with aniline dyes, the ends coloring more deeply than the middle. It does not form spore. It grows well in blood serum, in the form of white moist, iridescent colonies. It grows slowly in gelatin but rapidly in glycerin agar, forming a grayish white surface growth. In bouillon it grows in a very characteristic way, resembling the growth produced by the erysipelas organism. The culture medium appears clear, with white granular deposits on the walls and in the bottom of the tube.

It is pathogenic for rats, mice, guinea pigs and rabbits, which die usually within two or three days after inoculation. The bacillus soon loses its virulence when grown in artificial media. The virulence of the organism is increased by successive inoculations in certain animal species.

We are indebted to Yersin, Calmette and Borrell for the antiplague serum. Animals are immunized against the attacks of the organism by repeated intravenous or intraperitoneal injections of dead cultures or by subcutaneous inoculation. A horse was immunized in about six weeks. The serum afforded protection to small animals after subcutaneous injection of virulent cultures, and even cured

those that had previously been infected if administered within twelve hours after the inoculation. Yersin has recently reported the successful treatment of a man who was attacked by a severe type of the disease. The French Consul at Hong Kong performed the same operation upon two other pupils at the Catholic Mission with success.

Baldness Microbe.—One of the physicians at a hospital in Paris has, it is stated, discovered a microbe of the skin which accounts for baldness. It appears that baldness attacks those whose skin exudes an excessive amount of fat or oil, and the parts affected are washed with ether and other solutions, myriads of small microbes may be seen similar in length (!) to the tuberculosis bacillus. This particular skin microbe varies in size according to its age and position. For instance, on the scalp it is smaller than on the face or the body, but the structure remains always the same. The doctor has inoculated a sheep and a rabbit with the skin microbe at the Pasteur Institute, and he will make known the results of his experience to the Society of Dermatology. It is stated that there are three or four therapeutic agents capable of destroying the fatty substance of the skin complained of.

MEDICAL MICROSCOPY.

The Klebs-Loeffler Bacillus in Apparently Normal Throats and Noses.—W. H. Gross (University Medical Magazine, October, 1896) presents an interesting report of some observations made in the Children's Hospital of Boston. During six months ending June 1, 1896, culture examinations were made from the throats and noses of all cases entering the hospital; two cultures, twenty-four hours apart, being taken on admission, and subsequently repeated once weekly as long as the case remained in the house, unless the Klebs-Loeffler bacillus was found, in which case daily examinations were made until three successive negative cultures, twenty-four hours apart, were obtained. The work was undertaken with the object of

preventing outbreaks of epidemics of diphtheria, which in past winters had occurred in this hospital with most disastrous results.

Out of 316 cases examined, 26 at one time or another showed the presence of the Klebs-Loeffler bacillus. Two of these had clinical diphtheria, so that out of 314 normal throats and noses, 7.9 per cent contained the bacillus of diphtheria. The average persistence of the bacillus on the mucous membrane was fifteen days; the shortest period one day, the longest 103 days. The nose was the principal habitat in 65 per cent and the throat in 35 per cent. The degree of virulence possessed by the bacilli in the various cases was not determined.

Antitoxin in Diphtheria.—The American Pediatric Society are about to undertake a second collective investigation of antitoxin, and they now ask that records of cases of diphtheria involving the larynx, whether operated or not, occurring in the United States, be sent to the Secretary, W. P. Northrup, M.D., 57 East Seventy-ninth street, New York, N. Y.

The following sums up the conclusions of the Society based on the first investigation:

Dosage.—For a child over two years old the dose of antitoxin should be, in all laryngeal cases with stenosis, and in all other severe cases, 1500 to 2000 units for the first injection, to be repeated in from eighteen to twenty-four hours if there is no improvement; a third dose after a similar interval, if necessary. For severe cases in children under two years, and for mild cases over that age, the initial dose should be 1000 units, to be repeated as above if necessary; a second dose is not usually required. The dosage should always be estimated in antitoxin units, and not of the amount of serum.

Quality of Antitoxin.—The most concentrated strength of an absolutely reliable preparation.

Time of Administration.—Antitoxin should be administered as early as possible on a clinical diagnosis, not waiting for a bacteriological culture. However late the

first observation is made, an injection should be given unless the progress of the case is favorable and satisfactory.

Bacteria in the Urine in Non-bacterial Febrile Disease.
—Chvostek and Egger (Wiener Klin. Woch., 1896, No. 30) report the occurrence of bacteria in the urine in paroxysms of malaria and in fever produced by injections of tuberculin. As the experiments were conducted in such a way as to exclude the usual causes of error in such observations, the authors believe that fever serves in some way to favor the excretion of micro organisms, though no bacterial disease in the usual sense exists. They suggest that this may be simply the exaggeration of a process which must occur at times in healthy persons. Bacteria gain entrance to the blood in various ways, perhaps most frequently by way of the lymphatics, and are finally excreted with the urine. These germs are probably more or less lowered in vitality, so that they cannot often be cultivated successfully; but in fevers such as the authors worked with, the excretion is more rapid. These and other observations show that the presence of non-specific bacteria, especially the *Staphylococcus albus*, in the urine cannot be looked upon as of great importance, and that other facts must be brought forward in order to prove their relation to the disease.

BIOLOGICAL NOTES.

The Scandal on Oysters.—At the recent meeting of the British Medical Association, Professors Boyce and Herdman took pains to show what persons familiar with the natural history of the oyster have known all along, that it is not a scavenger, as some people have ignorantly alleged but a cleanly and docile animal of slow movement and over-trustful of its pampering caretakers. Consequently it has been most foully treated. The professors cited and verified facts that had been before stated—namely, that when oysters were laid down in pure water a natural process of

cleansing took place, and previous sewage contamination was thus entirely got rid of. This result forms the highest possible argument in favor of the absolute purity of the surroundings of oysters during their cultivation or after being laid down in special beds for fattening purposes.

With regard to the germs of typhoid fever in sea water or in the tissues of the oyster, it was shown that they are viable for fourteen days in sea water at 35 degrees centigrade, while in cold sea water they may live for twenty-one days; and when large quantities of the microbes are added to the water, their presence may be demonstrated for a longer period than when small quantities are employed. It thus seems that the bacilli do not actually breed or multiply in the sea water at all. Infection from this source, therefore, is from germs that have entered the water, and not from their descendants and progeny. It was also demonstrated that the typhoid microbe does not increase either in the body or in the tissues of the oyster. Where oysters are infected with typhoid germs and placed in a stream of pure sea water, the bacilli disappear in from one to seven days. The oyster evidently utilizes its pure environment to get rid of its unwelcome and uninvited germ guests.

Distinctions Between Human and Animal Blood.—On mixing the blood in question with a little bile, there are formed crystals not exceeding 0.003 meter in size. Those of a man are right rectangular prisms; those of the horse, cubes; of the ox, rhombohedrons; of the sheep, rhombohedral tablets; of the dog, rectangular prisms; of the rabbit, tetrahedrons; of the squirrel, hexagonal tablets; of the mouse, octahedrons; of common poultry, cubes modified at their angles, etc.—Scientific American.

MICROSCOPICAL NOTES.

The Night Lunch Wagon.—Mr. John F. Hurley, president of the water board, of Salem, Mass., who has been indefatigable in promoting a good water supply, has now

called attention to a matter which effects the public health in a different degree. Disclaiming any intention of needlessly interfering with any person's means of livelihood, he has protested against the licensing of night lunch wagons, on account of the liability of the spread of disease by this means. These wagons are a familiar sight in the cities and larger towns. Either they are driving about the streets or they occupy a stand, night after night. Mr. Hurley has interested himself to inquire into their operation and finds when ready for customers the water supply of a wagon consists of about two gallons of water in a bucket. During the night several hundred cups of coffee and mugs of milk are sold and emptied into mouths many of which are dirty and diseased, some foully so. The cleansing of the mug or cups consists of a rinsing in the bucket of water and a wipe with a towel that does duty for the entire night. We must agree with Mr. Hurley that probably no better method of spreading disease can be found than the practices he describes, and the subject is one which should receive the attention of the board of health in the cities where such a menace to public health exists.—The Engineering Record.

Infection by Pets.—Cats have been suspected of conveying the infection of diphtheria, and scarlet fever has been traced to them. To this may be added (Chicago Medical Record) the unwelcome news that a health officer has reported a case of smallpox brought about in the same way; that is, by a cat from an infected house carrying the disease to a neighboring house.

Another case is reported in *La Medecine Moderne*, "of a seamstress who was in the habit of allowing her dog to lick her face. She was attacked one day with a severe inflammation of the right eye. Oculists were consulted, but their treatment was unsuccessful; and owing to the fact that inflammation of the left eye was beginning, the right eye was cut out. In it was found a tapeworm, which the dog had probably picked up while licking some less pleasing object than his mistress's face.

"The danger of the transmission of parasites by dogs, who are well known to be indiscriminate in choosing objects for the exercise of their tongues, to the hands and faces of their masters, would seem to be a great one. It is remarkable that accidents of the kind related happen as rarely as they do."

MICROSCOPICAL SOCIETIES.

Royal Microscopical Society.—At the last meeting of the society, Mr. F. Enoch, F. L. S., F. E. S., showed under microscopes a unique collection of specimens of "a much neglected family," viz., the mymaradæ. These insects, some of them much tinier than a grain of sand on the sea-shore, are egg-parasites, that is to say, they prey on the eggs laid by other insects—some of them in the live bodies and still other minute denizens of London trees. The researches conducted by Mr. Enoch have brought to light some eight hitherto unknown genera, and latest was discovered at Holloway. Mr. Enoch prepares, mounts, sketches and photographs the specimens for which he hunts by night and by day in London and the suburbs, and the exhibition which he arranged was of much interest.

New Jersey State Microscopical Society.

Monday, April 26, 1897.—At Kirkpatrick Chapel, Rutgers College Campus, New Brunswick, N. J., was held the twenty-eighth anniversary meeting of the New Jersey State Microscopical Society. An efficient committee, chairmaned by Dr. Chester had striven to make the meeting attractive to the public and had signally succeeded.

Dr. Julius Nelson, President of the Society, made a brief speech of welcome and introduction. He called attention to the fact that the Society is not among the least educational factors in this city. Meetings are held, month by month; popular subjects, easily understood, are treated of by specialists; and the public is always welcome, admission being given gratis. The facilities offered are unique in this city.

"The microscope," said Dr. Nelson, "has made greater revelations than the telescope. The views which you shall behold this evening, projected from a polarizing apparatus perfected by Dr. Van Dyck, have not been shown to an audience of this kind before."

Dr. Van Dyck then explained the polarizing projection lantern, giving the theory of light vibrations and telling the effects of interference between waves of light. Polarization is acquired when all parts of a medium move alike and in the same direction. By means of a bundle of glass plates, arranged in a certain way, he had perfected the projecting apparatus.

While Dr. Van Dyck managed the lantern, assisted by Frederick H. Blodgett, secretary of the society, Dr. Chester explained the views. They were magnified from the slides 160,000 times, being projected from a one-quarter inch aperture to an area upon the screen of about eight feet.

"Beautiful" is too feeble a word to describe the tints which the rock crystals and the organic particles assumed under polarized light. Again and again, as the more exquisite specimens were shown, the audience gave expression to its delight in applause. When inorganic specimens—crystals formed by chemicals—were projected, much amusement was occasioned. By some arrangement of the apparatus, the crystal "wheels went around," changing their hues the while.

Part II of the scientific entertainment was held in the lecture room in the rear of the chapel. Here were half a hundred microscopes, with specimens well mounted and displayed under both electric and oil light, arranged on tables. The visitors passed up one row of microscopes, peeping into the tubes as they walked, and down the other row. These were the exhibitors and their exhibits:

College Experiment Station; Photo-micrographic Camera

Dr. J. B. Smith; Eggs of the Tape-worm, Head of the Tape-worm, Mouth of the House-fly, Mammalian Sperm, Wing Cover of a Beetle.

Dr. B. D. Halsted; Starch in Cells of Bean Seed, Spores of a Parasitic Fungus, An Akebia Stem, Carnation Rust in a Leaf.

Mr. F. B. Kilmer; Section of Sponge, *Bacillus pyocyaneus*.

Dr. P. T. Pockman; Stomata in Fern Leaf.

Mr. F. H. Blodgett; *Protococcus*, Zoospores of *Draparnaldia*, Mandible of Lady-bug.

Mr. F. H. Blodgett; Wild Flowers.

Dr. W. W. Knox; Foramenifera.

Dr. A. C. Hutton; Pappus of Marguerite.

Prof. C. L. Speyers; Spicules of *Gorgonia*.

Prof. W. S. Myers; Humming Bird Feathers.

Dr. A. H. Chester; Arranged Diatoms.

Mr. J. M. Devoe; Tongue of Beetle, Foot of Spider.

Dr. M. H. Hutton; Fossil Diatoms.

Mr. F. C. Van Dyck Jr.; Pollen of Japan Lily.

Dr. F. C. Van Dyck; Micro-photograph of Plants.

Dr. D. C. English; Section of Human Appendix, Kidney of Mouse.

Dr. H. R. Baldwin; Hair Bulb, Flea, Cheese Mite, Feather of Goose.

Dr. F. M. Donahue; Section of Scalp.

Mr. J. A. Manley; Iron Pyrites.

Dr. Caroline H. Marsh; Section of Spinal Cord.

Mr. L. H. Noe; Platinocyanide of Yttrium.

Dr. Julius Nelson; Frog's Kidney, Human Kidney, Human Hair.

Dr. Julius Nelson; Various Hairs, Various Fibres.

Mr. W. W. Wilson; Root-cap.

Mr. L. T. Ives; Butterfly Scales.

Dr. A. L. Smith; Normal Artery.

Dr. N. Williamson; Pathological Artery, X-ray Photograph of Ibis.

Mr. W. S. Valiant; Casts of *Triarthrus beckii*.

Mr. Thomas Craig has found an apparently new rotifer. The peculiarity of it is in the fact that it is enclosed in a case made of grains of sand and small diatoms.

THE MICROSCOPE IN SECTION.

1. Compensation ocular x 12 ; it is a positive ocular
2. Draw-tube, by which the tube is lengthened or shortened.
3. Main tube or body, to the lower end of which the objective or revolving nose-piece is attached.
4. Society screw in the lower end of the draw-tube.
5. Society screw in the lower end of the tube.
6. Objective in position.
7. Stage under which is the substage with the sub-stage condenser
8. Spring clip for holding the specimen.
9. Screw for centering, and handle of the iris diaphragm in the achromatic condenser
10. Iris diaphragm out-side the principal focus of the condenser for use in centering.
11. Mirror with plane and concave faces
12. Horse-shoe base.
13. Rack and pinnion for the sub-stage condenser.
14. Flexible pillar
15. Part of pillar with spiral spring of fine adjustment
16. Screw of fine-adjustment.
17. Milled head of coarse adjustment.

[From Gage's "The Microscope and Microscopical Methods."]

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On a New Fossil Marine Diatomaceous Deposit in Alabama.

By K. M. CUNNINGHAM,

MOBILE, ALA. .

In the issue of this Journal for August, 1896, there appeared a paper giving an account of the results secured by myself from an examination of a rather wide area of strata of Tertiary age undertaken during the month of June 1896. It contained much of interest in relation to the various kinds of microscopic fossil organisms found in the various deposits encountered, and in the same article I referred briefly to the locality around Suggsville. At the time of preparing that paper, I had inadvertently overlooked a few specimens collected near Suggsville. In December last while arranging and labeling specimens of the minerals previously collected I found some small samples of clay. It occurred to me that I had not made a micro-analysis of the same, and with this in view I made a trial test. I found that the material indicated a very interesting deposit of fossil marine diatoms hitherto unknown, and offering much of interest to diatomists and microgeologists in general. After ascertaining this fact it became necessary to secure a relatively large amount of the deposit for the purpose of introducing the same to the notice of all who might desire to study the contents and peculiarities of the new deposit. I therefore found it necessary to communicate with Dr. C. I. Dahlberg, of Suggsville, indicating the situation of the

deposit, requesting him to visit it and send me a quantity of the deposit. Through his kindness I secured some fifty pounds of clay, and after the receipt of the fossil clay I was enabled to make a study of the deposit.

After preparing and examining the equivalent of about fifty slides, I became sufficiently acquainted with the chief characters of the deposit, to enable me to make some comparative deductions with reference to the two principal sources of North American marine fossil deposits. These are generally known and familiar to American and foreign microscopists. Such deposits are known as occurring at Monterey, Cal. and at other sites on the Pacific Coast. The deposits on the Atlantic Coast are found at Nottingham, Md, Richmond and Petersburg Va., and at other points from New Jersey to South Carolina.

As a result of the studies made from a relatively small quantity of the deposit, not amounting to more than a few ounces in the aggregate, I have been enabled to note and tabulate species represented by the following genera: *Amphora*, 5; *Amphiprora*, 4; *Auliscus*, 3; *Aulacodiscus*, 3; *Actinocyclus*, 3; *Actinoptychus*, 6; *Asterolampra*, 2; *Amphitetras*, 2; *Biddulphia*, 6; *Coscinodiscus*, 10; *Craspedodiscus*, 2; *Cocconeis*, 1; *Cyclotella*, 2; *Corinna*, 2; *Diatoma*, 2; *Dimeragramma*, 1; *Diplo-neis*, 3; *Eunotogramma*, 1; *Glyphodiscus*, 2; *Hyalodiscus*, 2; *Hemianulus*, 2; *Melosira*, 5; *Navicula*, 10; *Pleurosigma*, 3; *Pyscilla*, 2; *Pseudoauliscus*, 1; *Rutilaria*, 1; *Raphoneis*, 2; *Synedra*, 1; *Triceratum*, 6; *Trinacria*, 2;—approximating one hundred species in the aggregate. Associated with the diatoms are additional fossil organic remains viz. some 20 species of Foraminifera, 6 or more of Radiolarians, various sponge and gorgonia spicules, minute spines of echinoderms; stellate spicules, zanthidian spheres, and coccoliths of the chalk resembling those of the recent sea bottom; also crystals

of selenite, and matted crystalline plates. The contents of the deposit offer many points of study interest.

With regard to the richness of the deposit, it becomes only a question of concentration and cleaning as the diatoms are in illimitable numbers, a fragment as large as a lima-bean yielding three or more slides of the usual size. A few peculiarities to be noted by the student are of the following character. The Coscinodiscoidal forms range in size from 1-50 inch to 1-500 inch. Of *Melosira* there are simple closed rings and spiral forms of two or more turns; filaments of *Melosira* having as many as fifteen frustules united together. The *Triceratia* are sometimes found in filaments of three or four frustules in a linear series; spherical Coscinodiscii united in pairs in a partial fission or sporangial stage. In these the external hemispheres are fully completed in their reticular surfaces, and the internal halves either perfectly or partially formed, but still enclosed by the sporangial isthmus or hoop. There are *Amphitetras* in prefission union or sporangial stage inclining the frustules to rest on the longer axis. The discoidal forms of all kinds have both valves united to the hoop thus enabling the sculptural details of either top or bottom surfaces to be examined with equal facility in focussing down from one surface to the other or vice-versa.

By this means, it is seen that in all of the *Aulacodiscii* or *Glyphodiscii* having processes or bosses on both surfaces that upon focussing on the upper surfaces, and then through to the lower surfaces the bosses or processes of the lower surfaces bisect the position of the upper bosses. This furnishes a proof that the valves are intact, a circumstance seldom observed in other fossil deposits.

The formation in which this deposit is found is known as gypsous in character. This is owing to the fossil Foraminifera and Diatoms having been mineralized or metamorphosed by two agencies. As a result this tends to

make the cleaning and preparation of the diatoms for study somewhat difficult, or at least a lengthy process. The diatoms are associated with a tenaceous clay matrix very difficult to eliminate by boiling or acid treatment. It may be easily removed by trituration on a soft rubber surface freeing the silicious organisms in abundance; and when they are so freed, it is noted that the surface and interior of the diatoms, especially the *Biddulphia*, and *Actinocyclus*, are densely packed with crystalline bundles. These crystals may be removed by digesting in a mixture of equal parts of sulphuric and hydrochloric acids.

It will also be noted that the larger *Coscinodiscii* are encrusted with blackish spherules of ironpyrite. This can be removed by digesting in nitric acid. When the acid treatment is properly carried out, fair slides may be prepared; but while the requirements noted here may seem formidable or tedious, there is a very simple and direct process that any one can use for all essential purposes of study. For this purpose it is merely necessary to take a piece of the crude diatomaceous clay as large as a lima-bean, wet it with water, place it in the palm of the left hand, and crush it down by the pressure of the fingers of the right hand. Then, with the tip of the index finger of the right hand the clay is continuously triturated until no visible small particles or lumps are evident. In the trituration, utilize as much surface of the palm as the hand will permit. The triturated layer is then removed clean from the hand by a pocket knife blade and transferred to a small shallow saucer-like vessel. Water is added, and the paste is dabbled, which will free the diatoms. Allow them to settle to the bottom. The clay water is then poured off carefully, and additional water added a few times to remove the remaining flocculent matter. Then the diatoms may be readily concentrated by a gentle twirling on an incline and tilting to one side. Then a pipette will remove the dia-

toms leaving the larger and coarser portions to the rear. By this means enough diatoms may be secured for a trial study of five or more slides from a very small piece.

This simple process is susceptible of great refinement when properly done. It is the most expeditious way in which to get acquainted with the characters of the deposit; whereas, if the process does not give satisfactory results at the hands of anyone trying it, the customary process of boiling in alkaline, or acid solutions would have to be resorted to. More time is thus consumed and it will scarcely remove the amorphous clay particles which are apt to interfere with a good concentration. I deem the suggestions given herein as pertinent, as the deposit belongs to the category of deposits seldom available, and thus involves experimental tentative processes for its mastery.

The deposit offers a problem to the chemist, viz: to find an acid or combination of acids which will promptly dissolve the compound mineral which has metamorphosed the internal chambers or casts left by the Foraminifera. These shell casts seem to be proof against four of the commoner reagent acids. This problem offers a fine experimental field in the line of micro-chemistry.

If a simple water cleaned slide of the diatoms is placed under the microscope using a 1 inch or a $\frac{1}{2}$ inch objective remarkable chemical phenomena may be observed. By depositing a drop of sulphuric acid on the slide, and then adding a drop of muriatic acid, every foraminiferal form will be violently attacked and torrents of gas bubbles will be thrown off in streams until the internal casts within the foraminifera are exposed. Then the power of the acids is at an end. In the meantime the diatoms will have been materially brightened, revealing the sculptural markings more clearly, where not masked by pyrites. The action of the nitric acid in dissolving the iron mineral does not present any phenomenon of inter-

est as it is rather slow in its action. It seems to be essential in improving the appearance of the preparations.

During the course of my studies of this new deposit I made sketches of all the forms found in the material in the hope of being able to identify the various species, but I found that it was a hopeless task to identify the majority of the species with certainty. I had available one Moller Type Plate, one Getchsman Type Plate, covering some five hundred species, Kain's Blue print copy of Adolf Schmidt's Atlas (80 plates only) and Wolle's Diatomaceæ of North America. All of these were only serviceable as giving the genera alone. The identification of the species with their aid was impracticable. The identification of a species involves the highest critical skill, as indicated in the critical notes attached to Schmidt's figures. So I leave the determination of the species characterizing the Suggsville deposit to those who have a genius for such work.

Immediately on determining that I had found an interesting and new deposit with unfamiliar North American species I at once forwarded to Mr. J. Tempere, of Paris, a specimen of the new earth. He replied that he had received the material, and that he would clean it, and send me a list of the species contained in the same. Six months have elapsed and nothing in reference to the deposit has been received from him. This may show that it takes time to determine with accuracy the species in an unfamiliar deposit.

Incidentally there is an element of scientific romance connected with the Suggsville find which may be stated in this wise: Some ten or more years ago a letter came to me from the Alabama State Geologist, Dr. E. A. Smith, enclosing a letter of inquiry to him from an Atlantic Coast Geologist. It asked whether there was a known fossil Marine Diatomaceous deposit within the bounds of Alabama. The party writing was interested in the sub-

ject from a geologic standpoint. The letter was referred to me for a reply, as I was supposed to be the only person in Alabama that could give the information.

At that date nothing was known of a fossil Marine deposit of any kind, not even a fresh water fossil deposit was known. We only had available the recent Marine Diatoms of the Gulf and the likewise recent fresh water sources. Since that date, the whole Diatom subject is practically exhausted for this locality, and duly put upon record for the benefit of the whole world.

The writer of the letter proved to be Lewis Woolman, of Overbrook, Pa., but latterly of Philadelphia, Pa., who in connection or in collaboration with the Geological Survey of Pennsylvania, has been identified with the study of water-bearing strata or horizons as determined through the study of Artesian well borings and other sources. He is also the originator of an hypothesis involving the assumption that, in the epoch in which the Miocene strata were laid down or deposited, there was deposited along the Atlantic Coastal area a series of Diatomaceous clays, one stratum of which in particular represented by a deposit of at least 300 feet in thickness, and designated by him the "great 300 foot diatomaceous stratum." He had reason to believe it might be traced somewhere all along from New Jersey to the Florida peninsular, and sweeping around to and occupying a portion of the Gulf of Mexico Coastal plain even into Alabama.

It was with the object of collecting data to verify his assumption, that he sought the aid of many correspondents in securing material with which to establish the truth of his hypothesis. I rendered him every reasonable assistance by furnishing specimens. By this means, I put upon record at different periods, the important fresh water deposit of Montgomery, Ala., the fossil marine Diatomaceous clay from the Tampa, Fla. phosphatic area, the pyritized and mineralized diatoms of the Mobile, Ala.,

artesian well area clays 650 below surface, also the Radiolarian and Diatomaceous clays of the Buhrstone Eocene of Alabama and Mississippi, the Holothurian fossil remains of the Clarke Co., (Miss.) marls.

All of these various deposits were but of inconsequential interest to his purposes, as none furnished data of direct use to him. But finally a ray of hope dawned giving new zeal to his hope of finding the missing link in his data requirements, when the 15 feet or more stratum of a marine fossil diatomaceous clay was announced by me as found in the vicinity of Suggsville, Clarke Co., Ala. Mr. L. Woolman since then has had the satisfaction of getting the material wherewith to study the correspondence of the Alabama deposit in its specific forms, with the material and specific forms characterizing the composition of the Miocene clays of the Atlantic Coast.

The Geological Map of the State of Alabama locates Suggsville in the area of the Eocene designated as E. 1., equivalent to the St. Stephens; (Vicksburg; White Limestone, and Jackson) or uppermost member of the Eocene, while the true Miocene should rest upon this group of strata. A comparative study of the Pacific Coast Diatomaceous species and that of the Atlantic Coast species of the Miocene age by me suggests that the Suggsville deposit is more nearly allied to those of the Pacific deposits than to those of the Atlantic Coast.

Foraminifera of the Marine Clays of Maine. --By Frank S. Morton, Portland, Maine. 8 vo., 18pp., 1 plate.

This is a paper extracted from the proceedings of the Portland Society of Natural History for 1897. After a brief description of the localities from which the material was derived, the writer gives the systematic classification of the forms, and bibliographical notes. Students of the Rhizopoda can perhaps obtain a copy by writing to the author at Portland.

Remarks upon the Diatomaceæ.

By J. G. WALLER,

LONDON.

[From the President's Address before The Quekett Club.]

They are ubiquitous, and found everywhere in water, whether in the ocean, or river, or the merest trickling rill. It is an interesting fact, you can in many instances predict the character of what you will find, according to the conditions under which they exist, and they have more than any other organism been favored by constant research. The development of the microscope itself has gone on coincidently with our knowledge. Some diatoms have long been test objects wherewith to examine the highest powers. At the time when Ehrenberg wrote, probably most observers considered with him that they belonged to the animal kingdom; and this view lingered on, finding its supporters even when Andrew Prichard, in 1861, published his admirable compilation on the "Infusoria." Although this is now quite given up, one must not condemn too readily views that were partly suggested by the movements of certain species. Truth is a growth, the result of observation, but it is slow in progress, as the history of opinion on the most important of subjects declares unto us. But, if we assume that the movement of the Naviculaceæ was due to animal nature, the next step was to tell us how this was accomplished. So some observers distinctly saw a ciliated apparatus. This, however is the old story; you can always see what you wish to see, that which your mind has determined; and it is not agreeable to many, perhaps to most minds, to think that your eyes may deceive you. Yet this is a lesson that the microscopist must learn, and it is an important one. The study of the Diatomaceæ continually imposes this upon us. One species has exercised all

the faculties required in minute examination—the *Pleurosigma angulatum*—which has in itself a history singular in the various waves of opinion and attempted demonstration. The markings of its silicious envelope at first presented striæ, which further magnification determined into a series of semi-circular bosses, or at other times, according to other views, so many depressions or apertures. The first was once attempted to be illustrated by a glass tumbler, the sides of which consisted of so many raised bulbs. It was thought that a similar material would be similarly affected by the action of light and thus would prove, or tend to prove, the true construction of the valve. In the theory of elevations, it is not so long ago that arrangements were made in side illuminations by a pencil of light, thus supposing to give a true and artistic light and shade. But, in both these nice experiments, it seemed to be forgotten that they were begun in a foregone conclusion; and, as I have previously said, you naturally, in such a case, see what you wish to see. Certain accidents, fractures, and peculiarities inconsistent with the above-named views, assisted by careful illumination, seem now to have tolerably settled the question to be on the side of apertures, and my predecessor has worked successfully thereto. That this must be the general consent on such markings throughout the *Diatomaceæ* must probably be entertained, though it would be dangerous to affirm that there was no variation from it in the multiform changes of nature.

But the subject has been so admirably worked out and recorded by two papers in our Journal, one by Mr. C. Haughton Gill, April, 1890, in which is well described his mode of preparation of the objects wherewith to determine the structure. Another by Mr. Nelson, in May, 1891, goes into the same matter by the use of high powers, and these papers, showing a working on differ-

ent lines, yet arriving at the same results, commend themselves as conclusive. Nor can we forget the eminent services on diatom structure rendered by our Secretary, Mr. Karop, associated with further ideas on their development. But the diatom will never cease to be of primary importance to the microscopist, as the abundance and variety of its forms even exhaust our imagination, and the volumes written upon it, though numerous, seem to be only forerunners of more to come.

I have alluded to the movements which were once thought to be one of the reasons to indicate animal life, as seen in the Naviculaceæ; but in these forms it is by no means so remarkable as in one less commonly met with, viz., the Bacillaria paradoxa, wherein a number of parallel rods slide out side by side on each other, in a manner so curious as to challenge all hypotheses to clearly explain them to us.

But movement can in no way of itself be recognised as a distinction of animal nature, and many examples of the Algae, notably that of Volvox globator, go far beyond what is seen in any of the Diatomaceae, and sometimes there is a lingering of opinion here, as to which order the latter should belong. Hesitation of this kind has its value, as it directs attention to the subject, and, finally to a decision. Sponges are now relegated to the animal kingdom, but it is singular that doubts on this should have belonged to modern science; for Pliny, who wrote at the beginning of the Christian era, in his curious compilation, entitled "Natural History," distinctly saw the true place they should occupy.

One might quote eminent names near to our own time who have taken a different view, and it is remarkable, that one of such large experience as the late Dr. Gray, of the British Museum, should have been once on this side and considered the spicules the analogues of the hairs of plants. This comes out in a passage of arms between

him and Dr. Bowerbank, who could not avoid giving so home a trust as to remind him of it. Even after it was generally allowed that they belonged to the animal kingdom, a reservation was made for sometime before the fresh-water sponges were placed in the same position. Observers could not have seen, as I have, the blow-fly hovering over and depositing its eggs, attracted doubtless, by the offensive odor of decomposing flesh.

How the Bacterial Organisms are Studied.

BY J. E. LAMB, M. D.,

WAHOO, NEBR.

The technique of investigating these microscopic plants is manifold. Microscopy alone is inadequate. Identification requires other tests than those afforded by the microscope.

These tests are :—1. Staining agents. 2. Appearance of cultures. 3. Reaction to heat and oxygen. 4. Pathogeny.

1. *Staining agents.*—Watery solution of the aniline dyes penetrates the protoplasm in the cell bodies of most bacteria, yet the tubercle bacillus long eluded observation because it absorbs the solution only when the water is reinforced by some other agent like carbolic acid or alcohol. This microbe is stained with great difficulty, but once stained, it is very resistant to decolorizing agents. Upon these facts, all staining solutions and methods of staining are founded. Some operate slowly, others more rapidly.

In order to appreciate and differentiate the tubercle bacillus, the following solutions and methods of use, are more easy and simple to manipulate than any others with which the writer is acquainted. It is hoped they may prove as acceptable as those you are now using.

I. Fuchsin pulv, 15 grains; Alcohol, 2 drams; Aquæ distillat, 1 ounce.

II. Aquæ distillat, 1 ounce; Liquor ammonia, 3 minims.

III. Alcohol, 1½ ounces; Aquæ distillat, 6 drams; Nitric acid, ½ dram. Aniline green, to saturation.

To stain:

1. Gently press a small part of the most solid portion of the suspected sputum between two cover glasses.

2. During five minutes, place one cover glass in equal portions of solutions one and two, heated till vapor rises.

3. Rinse in water, put a drop of solution three on it, rinse again. If the mount is not a distinct green, put on another drop of solution three, wash again, dry and examine.

The use of the following will also afford gratifying results:

Ziehl's Solution.—Fuchsin pulv, 1 part; Alcohol, 10 parts; Acid carbolic, 5 per cent. sol., 100 parts.

Gabbet's Solution.—Methylin blue, 2 parts; Acid sulphuric, 25 per cent sol., 100 parts.

1. Prepare mount as above, hold high over a flame until dry.

2. Place cover-glass in Ziehl's solution five minutes.

3. Place cover-glass in Gabbet's solution one minute.

4. Dry, examine with oil immersion.

If a hurried diagnosis is unimportant, but permanent mounts desired:

1. Place cover-glass, with dried sputum, in Ziehl's solution twelve hours.

2. Hold in nitric acid, 25 per cent solution, till brownish black.

3. Hold in alcohol five seconds.

4. Hold in water one second.

5. Dip once in two, three, and four, if color is deeper than light pink.

6. Cover mount with Gabbet's solution two minutes.

7. Dry and examine as above.

A one-eighth or one-sixth objective, in other words, the enlargement of 400 diameters, with or without eye-piece multiplications, produces a clear field sufficient for diagnostic purposes.

Alcohol mixed with fresh sputum in order to preserve it, coagulates the albumen which should be softened with a two per cent solution of caustic potash before spreading over a cover-glass. A saturated solution of borax preserves the sputum, liquifies the mucus and does not coagulate the albumen.

Most cocci take Gram's staining readily. The gonococcus, however, being an exception, will not take Gram's method, this being one of its main diagnostic features. It takes all the ordinary aniline stains.

Gram's Solution.—Iodine, 1 part; Potassi Iodidi, 2 parts; Aquæ distillat, 100 parts.

The potash is not indispensable but added to facilitate solution.

2. *The color of colonies.*—If the individual bacteria in any given species be grown on a suitable soil, such as gelatine, bouillon or potato, there results a mass or colony of these minute plants whose size, shape and color afford essential means of differentiating the organisms, and the bacteriologist uses them for recognizing his minute plants just as the chemist uses the behavior of a given substance to identify his still more minute molecules. The streptococcus grows into light gray colonies while the staphylococcus produces bright yellow.

It is only when growing in masses that enough color is formed to be visible. Not infrequently are these colored masses so luminous that they can be photographed by their own light when placed in a dark room.

Indeed, the color of our mischievous microbe played a conspicuous part in many of those natural phenomena which, by their lack of apparent cause, were in early times relegated to the domain of the supernatural. That wavering, cold, uncanny phosphorescent light, seen at night time in putrid plants or by the sea side, is our innocuous microbe. The consecrated wafer placed in the bacteria-laden air of the church edifice over night was found besprinkled with crimson drops in the morning.

The legends are long and tragic of the dire calamities, unmentionable crimes and swift retributions which the strange appearance of our chromogenic microbe was supposed to foreshadow.

A recourse to the supernatural to elucidate all these natural phenomena, is no longer necessary, for to-day, we cultivate and study the tiny bacillus prodigiosus which made the drops of blood, the mingled green and blue phosphorescence.

3. *Heat and Oxygen*.—Like the larger plants, different species of bacteria require different temperatures for their growth. Most all grow well at 60° to 80° F., but the tubercle bacillus ceases to grow below 92° F.

As microbes assume very diverse forms in accordance with the nature of their environments, so also their habitat and mode of life divide them into very distinct classes.

The aerobines can subsist only when they breath the natural oxygen they withdraw from the atmosphere.

The anaerobines live within fluids and living organisms and derive the oxygen necessary for their respiration from the oxygenated substances in which they are found. To the latter class, belong all microbes which provoke pathological changes when introduced into the blood.

4. *Pathogenesis*.—Living animal tissues afford unfavorable soil for bacterial growth. When introduced

into animals a large majority produce no appreciable effect. It is now known, however, that upwards of thirty species are capable of nourishing themselves in animal tissues. No species is pathogenic in all animals but each only in certain kinds. The anthrax bacillus grows well in sheep but refuses to grow when planted in dogs and cats. Hence, the behavior of a given species when inoculated into different animals, is another means of differentiating the organisms.—St. Louis Medical Review.

Algæ found at Roche Abbey, July 11, 1896.

By J. NEWTON COOMBE,

CHAIRMAN OF THE SHEFFIELD SCHOOL BOARD.

The result of my microscopical examination of the gatherings taken from the Sandbeck Lake, and from the 'Wishing Well' and Lake at Roche Abbey, on the occasion of the Yorkshire Naturalists' excursion there on the 11th of July, 1896, has been eminently satisfactory as regards the Diatomaceae, which were the objects of my special investigation. Taking the above-named waters in the order in which they were visited, the well-known water weed (*Myriophyllum*) which grew very freely in Sandbeck Lake, and for a tube of which I am indebted to the courtesy of Mr. J. Stubbins, of Leeds, proved to be a favorite habitat for the following stipitate species of the Diatomaceae:—*Cocconema cymbiforme*, *Gomphonema curvatum*, *G. constrictum*, *Achnanthes exilis*, as well as of the needle-like *Synedra radians*, and the curious tube dwelling and somewhat uncommon *Encyonema prostratum*, the frustules of which last-named species move and pass one another up and down their hyaline mucous-made tubes in very curious jerky fashion.

The parasitic members of the family were well represented on the same weed by *Cocconeis placentula*, which appears like so many small lozengers stuck all over and

along the decayed portions of the weed from which the chlorophyll had departed. I was fortunate enough to find in Mr. Stubbins' gathering two of the frustules of this species in the interesting state of 'conjugation,' although too much attached to the weed to admit of being separated and mounted without injury to the specimen.

Coming to the water of the 'Wishing Well' at Roche Abbey, a dipping from which brought me by my wife some two years ago was found to contain an almost pure gathering of the by no means common filamentous Diatom *Odontidium mesodon* (W. Sm.), I was not a little pleased on this my first personal visit to find floating in the depths of the cool clear well water, a brown silk-worm-silk-like and perfectly pure mass of this interesting alga. After so successful a second find of this particular diatom, which I may say I have never met with in so pure and healthy a condition in any other of the numerous waters which I have examined in various parts of South Yorkshire, the 'Wishing Well' at Roche Abbey ought certainly to be noted by Yorkshire naturalists as a place to be visited by the lovers of freshwater algae in their search for "gems."

Proceeding to the Lake close to the Abbey ruins, it was but a few minutes before I detected upon the surface of this picturesque water a small piece (about an inch square) of that peculiar-looking yellowish-brown scum which to an experienced eye is a certain indication of a 'good find' of Diatomaceae. Upon examination under the microscope the gathering, of which, needless to say, I very quickly secured a tube, proved to be in many respects similar to an extremely fertile one I made some three years ago from the lake at Thoresby. Its special feature was its richness in unusually large frustules, .001" in length, of *Pleurosigma attenuatum*, which, after careful cleaning and boiling in nitric acid, give a brilliant opal iridescence of great beauty under dark ground illu-

mination with a magnification of two or three hundred diameters.

I have been able to identify and to mount in Canada balsam, and also dry, the following 58 species of the Diatomaceae in this one gathering, of which over 40 may be seen on a single slide under a $\frac{1}{8}$ in. circular cover glass :—

<i>Pleurosigma attenuatum</i>	<i>Navicula tumida</i>
“ <i>lacustre</i>	<i>Stauroneis anceps</i>
“ <i>spencerii</i>	<i>Cymatopleura solea</i>
<i>Nitzschia sigmoidea</i>	“ <i>elliptica</i>
“ <i>parvula</i>	“ <i>apiculata</i>
“ <i>amphioxys</i>	<i>Cymbella cuspidata</i>
<i>Tryblionella angustata</i>	<i>Amphora ovalis</i>
“ <i>gracilis</i>	“ <i>minutissima</i>
<i>Surirella biseriata</i>	<i>Diatoma vulgare</i>
“ <i>ovalis</i>	“ <i>elongatum</i>
“ <i>linearis</i>	<i>Odontidium harrisonii</i>
<i>Pinnularia viridis</i>	“ <i>mutabile</i>
“ <i>viridula</i>	“ <i>parasiticum</i>
“ <i>oblonga</i>	<i>Denticula sinuata</i> (?)
“ <i>gracilis</i>	<i>Gomphonema curvatum</i>
“ <i>acuta</i>	“ <i>constrictum</i>
“ <i>radiosa</i>	<i>Cyclotella kutzingiana</i>
<i>Navicula cuspidata</i>	<i>Cocconeis placentula</i>
“ <i>firma</i>	<i>Synedra ulna</i>
“ <i>amphisbæna</i>	<i>Cocconema lanceolatum</i>
“ <i>elliptica</i>	“ <i>cistula</i>
“ <i>gibberula</i>	“ <i>cymbiforme</i>
“ <i>inflata</i>	<i>Encyonema prostratum</i>
“ <i>affinis</i>	“ <i>cæspitosum</i>
“ <i>cryptocephala</i>	<i>Achnanthes exilis</i>
“ <i>binodis</i> (?)	<i>Eunotia monodon</i>
“ <i>bleischii</i> (?)	<i>Melosira varians</i>
“ <i>veneta</i> (?)	<i>Fragilaria capucina</i>
“ <i>producta</i>	<i>Colletonema neglectum</i>

This time of year and want of rain were not favorable for Desmids, but I came across a few vigorous specimens of the following species :—*Closterium striolatum* (showing very clearly the phenomena of cyclosis and so-called ‘swarming of the granules’ at its extremities), *Pediastrum granulatum*, *Cosmarium botrytis*, while among the less

common of the filamentous algae, I was fortunate enough to find in the Roche Abbey Lake, and subsequently to be able to mount in its own water a well defined gathering of *Oscillaria spiralis*, the curious and unexplained movements of which (as of a headless screw turning continually on its end) were extremely interesting to watch.

Several other and more common species of *Oscillaria* and at least three species of *Spirogyra* and *Zygnema* were abundant in the Lake.—The Naturalist.

Some Facts About *Podisus Placidus*.

BY A. H. KIRKLAND,

AMHERST, MASS.

During the month of May, 1896, while making field observations in Malden and Medford, Mass., upon the insects known to attack the gypsy moth, *Porthetria dispar*, I found that many of the common predaceous bugs upon emerging from hibernation greedily availed themselves of the food supply offered by the tent caterpillar and destroyed large numbers of this insect. They entered the tents and prey upon the insects.

When feeding, these Pentatomide insert the setæ only, and not the sheath, into the body of the caterpillar. I have watched them very carefully under a hand lens and my observations fully agree with those of Mr. Marlatt, as given in the Proceedings of the Entomological Society of Washington, D. C., Vol. II., p. 249. I have seen *P. placidus* extend its setæ beyond the end of the beak to a distance equal to the length of the last rostral joint. When the setæ are inserted in a strongly chitinized part, the struggles of the larva often pull them from the sheath. In such cases the beak is drawn through the fore tarsi in the same manner that an ant cleans its antennæ, and thus the setæ are forced back into the sheath. I have also removed the setæ of *P. cy-*

nicus from the sheath by means of a fine needle applied along the labrum and have seen them replaced in the same manner. The nymphs of this species were also found attacking the larvæ of the currant sawfly.—*Can. Entomologist*.

EDITORIAL.

Restriction of Vivisection.—A bill is pending in the U. S. Senate to restrict vivisection. Numerous men who consider themselves accurate observers are opposing it and are representing that it “prevents experiments upon living animals.” They show themselves to be neither accurate observers nor accurate readers for it does nothing of the sort. The bill permits:—(1) All the experiments performed while the animal is insensible to pain, (2) All kinds of surgical operations for testing new methods of surgical procedure, (3) The testing of new drugs or medicines, (4) All kinds of inoculation experiments or bacteriological investigations into the causes of diseases.

Out of 1239 replies from the leading physicians written on this subject, 968 have favored such restrictions as are made in this bill.

Dr. L. E. Rauterberg, late of the microscopical division of the Army Medical Museum has written to a senator as follows:

It was my lot for a number of years to be engaged in the microscopical division of the Army Medical Museum, where I saw practiced the most inhuman and barbarous mutilations of animals under the supervision, and with the sanction, of the United States officer in charge. A desired part or section of the animal would be removed, not under anæsthesia, and the poor beast would be then placed back in its cage or vessel until it suited the convenience of the operator to help himself to another portion so long as the animal would survive these tortures. I have thus seen animals with eyes, sections of brain, and other parts removed and kept in reserve for future experiment for a number

of days, and for the verification and repetition of results obtained and published years ago.

These unnecessary horrors, practiced openly with sanction of United States medical officers, make me think that stringent laws are needed to restrict such proceedings. None should be permitted not calculated to give additional useful information, and then under perfect anaesthesia, and under the supervision of a board of competent men assigned to that duty.

Aware of the possibility of such a condition in a scientific institution located in the District of Columbia and under the control of a government so supine, can any one, knowing of the existence of the above-named abuses, oppose a bill that aims to make such conduct amenable to law?

Nomenclature.—It has always been a source of surprise to us that men will spend so much time over questions of nomenclature and even of classification. The real nature of plants and animals furnishes a great variety of topics for study, and we ought to be able to interest ourselves therein to the exclusion of contests over nomenclature. Nomenclature has usually been based on a few superficial characters and has therefore been liable to incessant change as the result of discovering new facts. All this is a false view of matters and is not scientific.

A scientific nomenclature would be absolutely arbitrary. Let blue things be called *viridis*; let short things be called *longus*; let it be fully understood that pending the acquisition of full knowledge of a form our name is no clue to its characters. We must call it something but it matters not what we call it if we agree upon its name. An arbitrary name once affixed, let no one challenge it or seek to change it. 'As a sample of the foolishness which men of pseudo-science are forever indulging in, the following quotation will be of interest. It is from the Presidential Address delivered before the London Quekett Club recently and it is proper to apologize for filling our space even to this extent with such nonsense. Mr. Thomas and Mr. Carter are both too sensible men to waste time in frivolity.

Mr. Waller is wiser but might perhaps still better have omitted all allusion to the facts. In another place he shows good ideas of nomenclature by asking whether the names Leidy, Mills, Muleri, Bailey, Capewell, Ramsay, Everett, give any more information than letters or numerals. We far prefer the numerals.

The quotation is as follows:

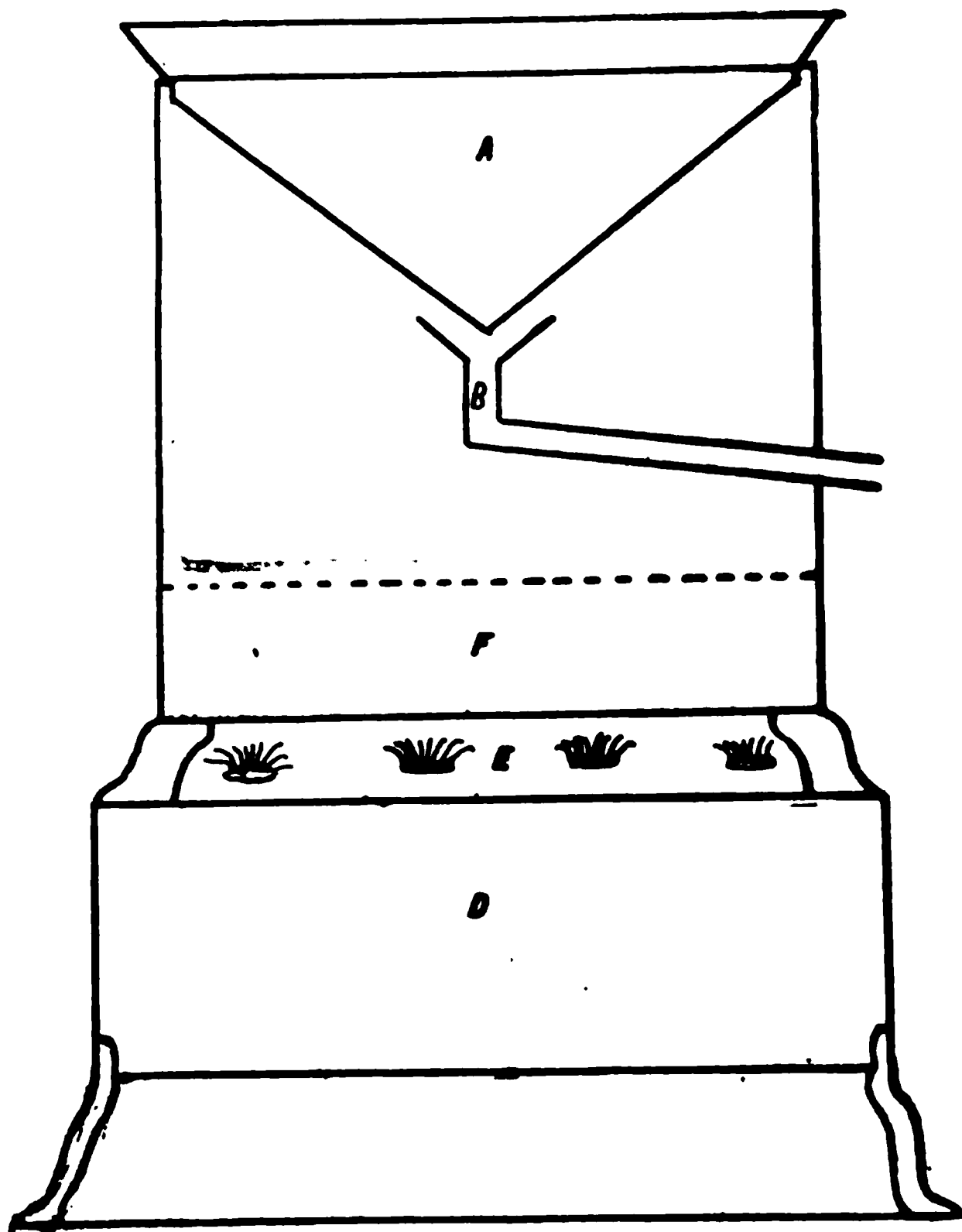
“When Professor Hitchcock, of the United States, was over here a few years ago I gave him a specimen of the *Ditchleys spongilla* for his collection, and others also distributed by or through me found their way to America, and I sent a slide to Mr. Carter. After some time had elapsed I heard that Mr. B. W. Thomas, an earnest worker of Chicago, had found the same variety in the river Calumet, and seeing its identity with that of *Ditchleys*, and finding that, in my description, I had declined specially naming it, he proposed to call it *Meyenia calumetica*. Then Mr. Carter, who had received a specimen from Mr. Thomas, saw that it was identical with that he had received from me turned his attention to the subject, and in an elaborate article in “Ann. and Mag. of Natural History” gave it the name of *Meyenia angustibiotulata*, which title Mr. Edward Potts, in his admirable “Monograph on the Fresh-water Sponges of America,” has accepted. Mr. Thomas then feels annoyed that he should thus be superseded, as Mr. Carter had, in the first instance, declared against its being a variety.

For myself, who first discovered it 19 years ago, and might have claimed some voice in the matter, I could not be otherwise than amused at the little quarrel amongst my friends, I having decided against giving the variation any separate name, my views leading me in another direction.

One satisfaction I have, however, gained in the knowledge that the *Spongilla* of the river Calumet is also found growing upon the stem of aquatic plants, as it tends to establish, what one would naturally feel, that similar conditions produce similar results.”

MICROSCOPICAL APPARATUS.

Distilling Water.—The most inexpensive method of distilling water is always a practical question. I have an apparatus that I had made which cost but little, and can be made upon a comparatively large or small scale—viz., for a small oil or gas stove to one the size of a cook-



stove, and can be made by any tinner or by any one who can cut tin and use a soldering iron.

Select the stove the size you wish to use, and the diagram will explain the process. A is the compartment for ice or cold water, F the water to be distilled, D the stove. The receptacle containing the ice or cold water should be

made to fit the lower receptacle tightly the same as the cover of an ordinary tin pail, and it will be readily seen that the steam rising from the water underneath coming in contact with the cooled surface above would condense and running down the cone-shaped condenser, drop into the small funnel.

As you will see, this can be made to fit the smallest of oil stoves, or any size larger as desired. It can also be used to make all kinds of flavoring waters by dropping the article, inclosed in a cloth, into the water to be distilled, the strength being determined by the amount put in.—A. J. Harris in Pop. Science News.

Note on Color Illumination. —Julius Rheinberg has designed a new form of substage differential color illuminator in order to simplify and facilitate the use of color discs and other stops in the substage of the microscope. It consists essentially of a box, or slide carrier fitted under the condenser, in which there are a number of metal slides which can be pulled out or pushed in quite independently of one another by means of little handles on both sides of the carrier. Each slide has two circular apertures, the one being fitted with a color disc or other stop, the other one being left free. The kind of stop is indicated on the handle. The openings in the slides are so arranged that when the apparatus is closed all the free openings coincide, so that illumination can be effected in the ordinary way. When any other illumination is required it is only necessary to pull out the particular stop, or combination of stops, each stop being in accurate position when pulled out as far as it will go.

In the apparatus there are 19 stops, viz., a dark ground stop, four stops which cause the background to assume various colors, four which cause the object to assume various colors, stops causing the object to be illuminated in different colors from opposite sides in various colors (for showing striations), and one causing the object to be illuminated in different colors at right angles to each other for showing striation etc., similarly situated. There are also

stops for oblique light, several annuli, and a ground glass stop, making a compendium no doubt somewhat too great for the general worker, but which is very serviceable to the experimentalists.

As far as color discs are concerned the stops are so arranged that all those which can be pulled out from the left side of the carrier cause the background to be colored whilst those which can be pulled out from the right side cause the object to be colored.

The number of effects which can be obtained with such an apparatus is unlimited. Mr. Rousselet showed us some weeks ago an ingenious color illuminator, by which, according to a little mathematical calculation, 36 effects could be obtained. By applying a similar calculation to this arrangement it would give some few hundred millions of combinations. This number may be too much even for an enthusiast, and one may prefer to pass over from the quantitative to the qualitative use of the arrangement.

For simplicity in use it cannot be excelled, as it allows of every kind of illumination and stop, being automatically brought into action whilst the object is under examination. The best result can, therefore, be obtained with far greater rapidity than ordinarily, and comparisons can be effected without having to bother about taking stops in and out, as in the ordinary way. The apparatus, although efficient, is needlessly clumsy and heavy. The principle can be easily adopted in a neater form, and made to fit any condenser.

How to Test Objectives is the subject to which but few pharmacists and physicians pay much attention. In a lengthy article on the subject by Dr. A. C. Stokes, published in the *Journal of the New York Microscopical Society*, the writer says: "A severe test, then, or one that should come within the ability of the objective, and so fulfil the conditions of the ideal object for the purpose, is, for a first-class four-tenth-inch, the black dots of *Pleurosigma angulatum* in balsam, and perhaps, and imperfectly, the secondary structure of *Arachnoidiscus Ehrenbergii*; for a one-fifth

inch, the longitudinal lines of *Surirellagemma*, and the secondary structure *Isthmia nervosa* with the postage stamp fracture; for a one-eighth inch or for higher powers up to the one-twelfth the dotted secondaries of *Craspedodiscus elegans* in certain conditions.

MICROSCOPICAL MANIPULATION.

To Stain the Ringworm Fungus.—Adamson recommends the following method for permanently staining trichophyton:—1. Soak the hair in a 5 to 10 per cent solution of caustic potash on a slide for ten to thirty minutes. 2 Wash in 15 per cent alcohol in water. 3. Dry on slide, and in the case of scales fix by passing through the flame. 4. Stain fifteen to sixty minutes in aniline gentian violet made in the usual way, by adding a few drops of saturated alcoholic solution of gentian violet to aniline water. 5. One to five minutes in Gram's iodine solution. 6. Decolorize in aniline oil two to three hours or longer. 7. Remove superfluous aniline oil by blotting paper. Mount in Canada balsam.—Phar. Jour.

Frozen Sections.—Ethyl chloride might profitably be employed in preparing frozen sections for histological purposes. The results thus far obtained have been exceedingly satisfactory, and, while the method is somewhat expensive, no accessory apparatus is required for the microtome.

Hamilton's method of preparing the tissues for freezing gives good results. Another way of getting the tissue ready is that recently advised by J. Orth. One hundred parts of Muller's fluid are mixed when wanted with ten parts of formol. Small pieces of the tissue under examination are fixed and hardened in this solution in the incubator for three hours. At the end of this time they are removed and thoroughly washed, and alcohol is gradually added until they are placed in 95 per cent alcohol. This latter re-agent must, of course, be removed before the tissue is frozen. If desired, after washing, the specimen

may be at once transferred to the solution of acacia and sugar and frozen. Or, as suggested by H. Plenge the piece may be placed in a 4 per cent formal-dehyde solution for a quarter-of-an-hour, and then frozen in the same solution.

When the tissue has been prepared in some such manner, or even when perfectly fresh, it is placed with some formol and gum acacia fluid upon the specimen-holder of the microtome, and a small stream of chloride, methyl chloride or anesthetic (a mixture of these two re-agents) is played from above directly upon the specimen.

The tube containing the ethyl chloride is held about a foot from the specimen, and moved from place to place until the specimen is firmly attached to its base of support and the upper portion is coated with a few crystals of ice. These crystals are extremely small and delicate, and, therefore, do not injure the tissue so markedly as in some other of the freezing methods. The specimen is readily frozen in from 30 seconds to a minute. Sections are then cut and placed in water or fifty per cent alcohol, and mounted in the usual way. Excellent stained preparations may be prepared in fifteen minutes or less from the time that the tissue is removed from the body.

BACTERIOLOGY.

Differentiation of the *B. coli* from the *B. typhi abdominalis*.—Elsner (Zeitsch. f. Hyg. XXI.) uses plates prepared with Holtz's potato gelatine, to which, after it has been made slightly acid, 1 per cent of iodide of potash has been added. Even on this unfavorable medium the *B. coli* grows freely and quickly, but no colonies of the *B. typhi abdominalis* are visible for 48 hours, and they appear as extremely fine small, shining patches, like drops of water. Controlling his experiments by Pfeiffer's immune-serum process, Elsner always obtained positive results from typhoid stools. Piorkowski, at the Berlin Medical Society June 10, 1896, reported experiments in cultivating these bacilli on agar, bouillon, and gelatine mixed with urine,

which had been suggested to him by the presence of *B. coli* in the bladder. On these media the microbes grew luxuriantly, forming greyish colonies; the *B. typhi* abd. less rapidly in fine transparent patches. In the discussion Elsner said there were plenty of differential signs; the difficulty was to cultivate Eberth's bacillus when it was only present in small numbers—for instance, in water, or mixed with other bacteria, for example, in stools. Ewald, Wolf, and Senator, all had found Elsner's method very useful for the diagnosis of doubtful cases from the stools.—*Brit. Med. Journal*.

BIOLOGICAL NOTES.

Fertilization of the Gymnosperms.—A very important discovery in the mode of impregnation in Gymnosperms made by two Japanese botanists, Professor S. Ikeno and Dr. S. Hirase, which was recently referred to in our pages, supplies a most interesting link between this section of Phanerogams and the higher Cryptogams. Dr. Hirase has discovered that in *Ginkgo biloba*, *Salisburia adiantifolia*, impregnation is effected by antherozoids formed within the pollen-tube. The two nuclei resulting from the final division of the generative nucleus of the pollen-tube are converted, before entering the oosphere, into motile antherozoids, resembling those of the higher Cryptogams, but differing somewhat in form. They are ellipsoidal 82 microns long by 49 microns broad, and contain in the centre a nucleus entirely surrounded by cytoplasm. The main body consists of a head composed of three spiral coils, and a slender tail; to the former are attached numerous cilia. As soon as the antherozoids have escaped through the apex of the pollen tube, they enter the oosphere with a rapid twisting motion. Attraction spheres were observed accompanying the final division of the pollen-tube nucleus. Professor Ikeno has made a similar observation respecting the mode of impregnation in another Gymnosperm, *Cycas revoluta*. The antherozoids are here somewhat larger than in *Ginkgo*; the main body is composed

of four coils, to which are attached a large number of cilia; but the swarming motion was not actually detached. The nucleus is surrounded by cytoplasm. They are found in pairs in the extremity of the pollen-tube, and result from the bi-partition of the genative nucleus. Professor Ikeno states that the structure of the male and female organs in *Ginkgo biloba* and *Cycas revoluta* at the time of impregnation differs from that observed in any other Gymnosperm in this respect; that while, in the latter, the pollen-tube penetrates deeply into the archegone, in the two species under discussion it never reaches the archegone itself, but remains, at the time of impregnation, at some considerable distance from it. It would therefore be impossible for the pollen-tube-nuclei to impregnate the oosphere without being previously transformed into motile antherozoids. Fertilization is then rendered possible by the copious excretion of a watery fluid by the archegone at the time of impregnation. Further details of this most interesting discovery are promised.

The Wild Nettle is known to contain a remarkable number of useful qualities. The leaf is edible, and the liquid to be obtained from the stalk makes an excellent beverage. The fibre of the stalk may, under treatment, produce an excellent silk. For ages the plant has been used for this purpose in China, where it grows to a height of seven or eight feet. Only recently, however, has the machinery necessary to make the manufacture of this silk a profitable industry been produced. A machine called the decorticator has been invented, by means of which the fibre is stripped off in enormous quantities at a terrific speed. Ramie is the eastern name of the plant.—The Counsellor.

The Foot of the House Fly.—I have succeeded in mounting a specimen of the fly's foot with the pulvilli and tennent hairs stained, and showing, adhering to the ends of the hairs, the viscid globules by means of which the insect is enabled to attach itself to smooth surfaces. I have a fly's foot so mounted and stained with fuchsin,

which may be fairly well shown under a good dry lens. The details, however, are seen better with an oil immersion. Some of the hairs on this slide show the sickle filaments deeply stained and devoid of any adhering substance; others have a small quantity of the gummy fluid held within the hollow of the sickle, while the majority of the hairs are tipped with large globules that could easily be mistaken for permanent knobs or suckers.

The specimen also distinctly shows that the shafts of the hairs fringing the pulvillus do not spring separately from it, but each root or stem forks off near the base, forming two hairs.

I had hoped that staining would have rendered visible the orifice from which the adhering substance exudes, as the opening should be large, considering the size of the attached globules, but no such orifice has been detected. Judging, however, from the way the viscid substance seems in most cases to be held within the hollow of the sickle, it appears possible that a slit may exist along the filament capable of expanding and allowing the substance to exude freely.

The foot in question has been subjected to no cleaning process. Any attempt at such would inevitably clear away the globules adhering to the hairs, as is the case in ordinary preparations.—Eliot Merlin.

Preservation of Flowers.—The following is a very old method of keeping flowers without loss of color: Dry some very fine, pure siliceous sand in the sun or oven; then take a wooden, tin-plate, or pasteboard box sufficiently large and deep, and place your flowers inside erect; then fill the box with sand until the last is about an inch above the top of the flowers. The sand must be run in gently so as not to break the flowers. Cover the box with paper or perforated card board and place it in the sun-light, oven or stove; continuous heat gives the best results. After two or three days the flowers will be very dry, but they will have lost none of their natural brilliancy.—Journal of Horticulture.

DIATOMS.

Reproduction of Marine Diatoms.—Mr. G. Murray records some remarkable observations on the mode of propagation of certain pelagic diatoms collected off the coast of Scotland, chiefly belonging to the genera *Biddulphia*, *Coscinodiscus*, and *Chaetoceros*. In *Biddulphia mobiliensis*, “cysts” were observed within the parent cell, with only slightly silicified membrane, and destitute of the characteristic spines. These cysts appear to have the power of dividing and multiplying before assuming the characteristic parent form. A similar phenomenon was observed in *Coscinodiscus concinnus*, but in this species the protoplasm divides before the production of the “cysts,” two of which were found within the same parent frustule, differing from one another in form and in the width of the girdle-zone. It is not uncommon to find the young colonies of *Coscinodiscus* in “packets” of eight or sixteen; this being apparently the result of further binary division within the frustules, which are found accompanying them in an empty state. The membranes of these young colonies are only very slightly silicified or not at all; and they are, therefore, capable of increasing in size. A similar formation of “packets” of eight or sixteen young individuals within the parent frustule was observed in several species of *Chaetoceros*.—Proc. Royal Society of Edinburgh.

NEW PUBLICATIONS.

A Text Book of Histology. By Arthur Clarkson, Pp. 554, and 174 original colored illustrations. Bristol: J. Wright & Co. Price 21s. net.

In it will be found a full account of the latest, well-authenticated discoveries in the microscopic anatomy of the human body, and a very complete description of the preliminary processes necessary for making either temporary or permanent microscopical preparations of the various tissues. The colored illustrations form a prominent fea-

ture of the book, and although perhaps in a few cases somewhat diagrammatic, it must be conceded that for the most part they show extremely well the principal features visible in successfully stained histological specimens.

Browning's Paracelsus and other Essays.—By J. D. Buck. Robert Clarke Co., Cincinnati. 12mo., pp. 101. 1897.

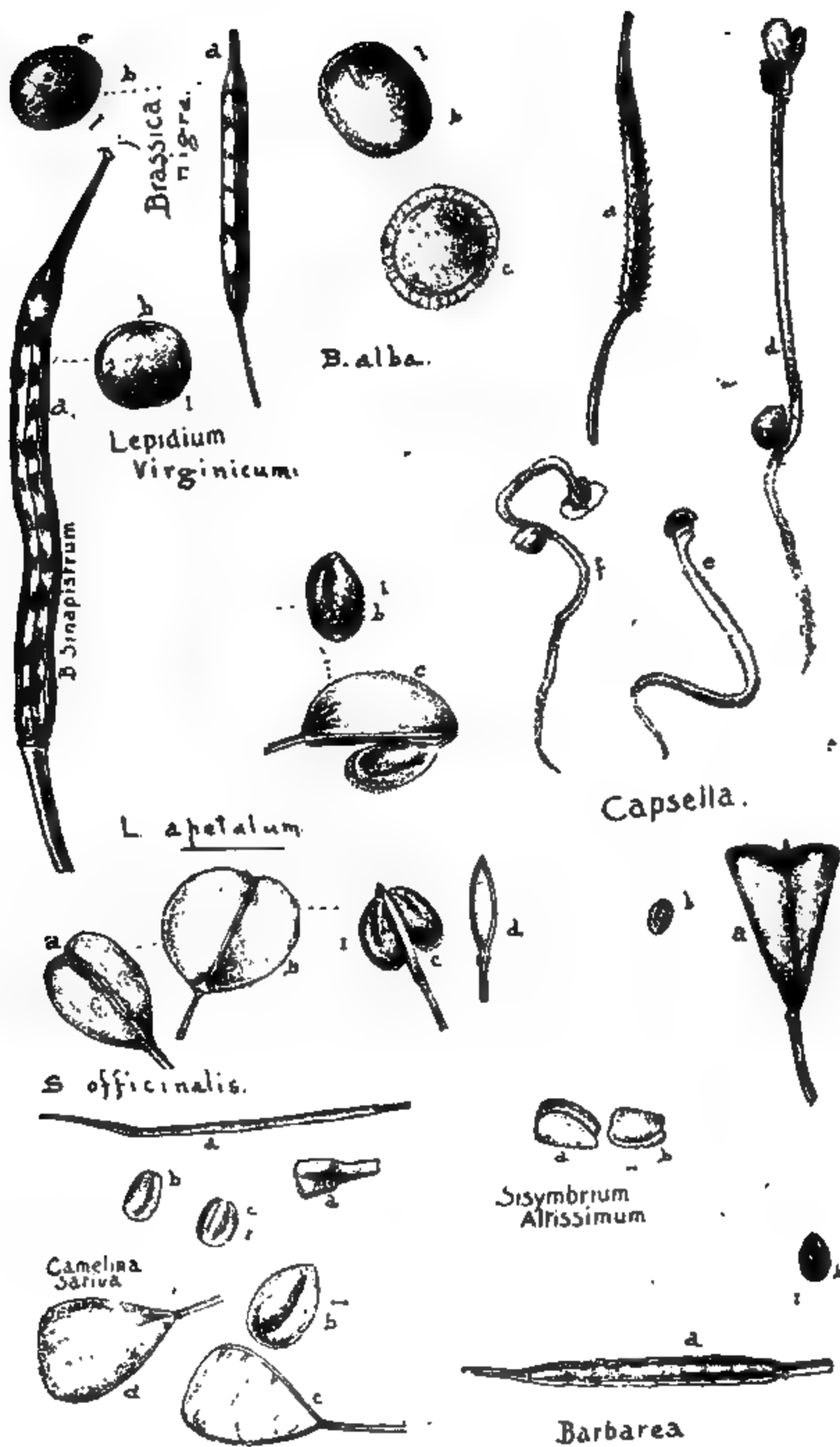
This little pocket volume containing four short essays is suitable to take along these summer Sundays when going into the woods or fields alone hoping to feel the touch of Nature. To read of Paracelsus, of Genius, of the Music of the Spheres, or of Idols and Ideals while lying on the grass amid the fragrance of flowers or the hum of insects will help to a glimpse of what most men and women never see and do not know to exist—something non-material within, about and around the material form.

I well remember my first experience of the "Music of the Spheres" in Switzerland in 1895. Only he who has heard it, however, will treat this essay as other than imaginative. He who wishes with sufficient earnestness to sense it can perhaps get assistance from this book.

The azure-blue cover and the gilt top make Dr. Buck's book a neat little present. The price is probably not over fifty cents.

Microscopic Researches on the Formative Property of Glycogen. Part I., Physiological. By Charles Creighton, M. D. Royal 8vo, pp. viii.—152. (London: Adam and Charles Black. 1896.) Price 7—6 net.

Glycogen is that substance in the animal body which corresponds very closely with the starch of plants and its appearance in the cells of different tissues during development. The book is illustrated by five well-executed colored plates. Chapter I is an Historical Introduction; II treats of Methods and Material—viz., Microscopic Method, method of using iodine, preservation of sections, color of the iodide of animal starch, and reaction with methyl violet. The remaining eleven chapters treat of glycogen as found in various parts of the animal body.



SEEDS AND TESTA

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On the Seeds and Testa of Some Cruciferæ.

BY L. H. PAMMEL,

AMES, IOWA.

WITH FRONTISPIECE.

[Contributions, No. 6, Botanical Department, Iowa Agricultural College.]

It has been known for a long time that cruciferous seeds, when placed in water, become mucilaginous. Grew, the early anatomist, was acquainted with the mucilaginous character of some cruciferous seeds,—*Camelina*, *Turritis*, and *Lepidium*, as well as the plaintain and *Ocimum basilicum*. In this paper Grew refers to the use of seeds to collect foreign matter in the eye.*

De Candolle, in an early paper on *Brassica*, calls attention to the mucilaginous character of the seeds of the genus. The descriptions given by systematists are brief. The microscopic details are not noted. The following more recent writers have studied cruciferous seeds:—Caspary, Hofmeister, Sempolowski, Abraham, Schroeder, Henkel, Heraud, Schimper, Moeller, Harz, Hanau-sek, Strandmark, Wiesner, Flueckiger and Hanbury, Flueckiger and Tschirch, Tschirch, Tschirch and Oesterle, Klencke, Hoehnel, Kiaerskou, Strasburger, Sachs, Hager, Nobbe, Vogl, Berg, Oudemans, Garcke, Luerssen, Royle and Headland, Tietschert, Kratzman, Schenk, Behrens, Frank, J. D'Arbaumont, Van Tiegham, Godfrin, Zim-

*"Anatomie des plantes. Qui contient une description exacte de leurs parties et de leurs usages et qui fait voir comment elles se forment et comment elles croissent. French Translation, second edition, Paris, 1679, p. 199.

merman, Bonnier, Hicks, and others. Some careful studies were made by Frank, Sempolwski, Hoehnel, Schroeder, Harz, Abraham, and D'Arbaumont.

During the past winter I had occasion to study several of our cruciferous weeds and in that connection a study of the seeds and testa revealed some interesting points, so that it has seemed wise to publish the results of this work, though it is not complete with reference to all the species described in Gray's Manual. The seeds are so characteristic that our weedy species are easily distinguished.

The seeds are round, flattened, oval, rough or smooth. These characters can be made out easily in sections. Cotyledons flat, incumbent,—the back of one cotyledon lying against the caulicle, or accumbent with the edges of the cotyledons towards the caulicle, or longitudinally plicate and partially enveloping the caulicle or conduplicate in cross section (Mustard) or spirally coiled in some cases. A section magnified shows that the testa consists of two well-defined layers and sometimes of a third, which is much compressed. The cell-walls of the outer portion are mucilaginous; those of the second thick-walled. The aleurone layer which various authors have considered as belonging to the testa is endosperm. Strasburger speaks* of the seed as being exalbuminous, and most systematic botanists so speak of it in this way. In the sense that this term was used by early systematic botanists this is correct. Humphrey has called attention to the aleurone layer of seeds and the use of the term. Endosperm of this character is found in the seed of many Leguminosæ where it cannot be made out with the naked eye. We have not thus far found it wanting in the order Leguminosæ. This layer corresponds to that found in

*Handbook of Practical Bot., English translation, Hillhouse, p. 339.

seeds of grasses and, as in that order and in Leguminosæ, the cells are filled with aleurone.

In Cruciferæ several rows of thick and poorly defined cells follow the aleurone layer, being especially marked between the caulicle and cotyledons. The cells of the embryo are quite uniform in size. Distributed through the cotyledons and caulicle occur the procambial vessels and the myrosin bodies in which myrosin is formed. This, according to Spatzier, is for protection and to break up the glucosides.

USE OF MUCILAGE.

The first and most obvious use of mucilage in cruciferous seeds is for the purpose of dissemination, especially in all smaller seeds. This can easily be seen in seeds like those of *Lepidium* and *Capsella*. And secondly for the retention of water on the surface, but this is of minor importance.

BRASSICA.

The anatomical structure of the seed of the genus *Brassica* has been studied by numerous investigators. We may mention the following: Oudemans, Tschirch, Harz, Flueckiger and Hanbury, Hoehnel, Hicks and others.

BRASSICA NIGRA, KOCH.

Pods smooth, one half to three fourths inch long, four cornered, erect, attached to a short pedicel and tipped with a short beak about one eighth of an inch long, about nine seeded. Seeds are black or reddish brown, occasionally grayish when more or less moistened; minutely reticulated. The seeds of this species are much smaller than in *B. Sinapistrum*—three fourths of a line in diameter.

The cuticle covers the epidermal cells as a continuous layer; when mounted in alcohol the outer layer is very much compressed and shows very slight stratification;

the cell walls expand and after it has been moist for a considerable time the cuticle breaks. Stratification is very evident on the addition of water. The second layer consists of rather thin walled parenchyma. The cells of this layer differ greatly with reference to their size, being scarcely at all developed in places, in others nearly as large as the cells of the outer layer.

The third layer consists of thick walled parenchyma cells, densely packed, radially elongated, thick walled, sides present a cone-shaped appearance. Underneath this is a layer of thick-walled parenchyma cells which contain some coloring matter. The endosperm follows this layer. The first layer consists of thick walled cells, densely packed with albuminous matter. The remaining cells vary in number, much elongated, thick walled with a small cavity; these cells extend down between the contiguous portions of the cotyledon or caulicle.

The Embryo:—The cells of the first layer surrounding the cotyledon or caulicle are smaller, filled with fat and protein grains. The remaining cells are larger also filled with fat and protein grains. The central part of the caulicle shows a differentiation of the embryonic vascular portion, consisting of small cells.

BRASSICA SINAPISTRUM, BOISS.

Pods one to two inches long, the seed-bearing portion somewhat torose and nerved, ascending, erect or sometimes appressed, tapering, prominently three to thirteen seeded, and tipped with the globular stigma, the upper one third to three fourths of an inch forming the beak, often with a seed. Seed globular, one line in diameter, brownish black, reticulated, the areas larger than in *B. nigra*, grayish when the seeds have been moistened, darker than *B. nigra*. When examined under the microscope with alcohol, the outer layer of cells is compressed, tabular, stratification not evident, cuticle well developed and forms a continuous layer over the outer cells; on the

addition of water, the cell walls become mucilaginous, elongate, stratification becomes evident, the cuticle breaks and an irregular surface is formed. The second layer is but slightly developed, made up of thin walled parenchyma cells. The cells of third layer are elongated and thickened laterally. These cells are much longer than in *B. nigra* and brown in color. The fourth layer consists of one to two rows of rather thin walled cells carrying pigment. Endosperm consists of several rows of cells; first row nearly isodiametric, filled with protein grains. The three or four layers of cells following are thick walled with a small cell-cavity.

Embryo.—First layer of cells nearly isodiametric, those following somewhat larger, filled with protein and fat grains.

BRASSICA ALBA, BOISS.

Pod very bristly, spreading. Seeds pale yellow, round or somewhat oblong, one to one and a half lines in diameter, average a little over a line. Cotyledons incumbent, folded around the caulicle.

The seeds of this species have been studied by many investigators. Parts of the seed are much stronger developed than in *B. nigra*. The first layer of cells is covered by the well developed cuticle. On the addition of water a copious mucilage is developed, the cell wall becomes strongly stratified. A portion of cell wall surrounding the cell cavity is more yellow and has a stratification of its own. When water has been allowed to act for some time, the cuticle breaks, thus causing an irregular margin. Cells of the second layer are somewhat irregular, thin walled, with a large cell cavity and small intercellular spaces; as a rule composed of a single layer of cells but in some places two well developed layers. The third layer consists of cells with lateral thickened walls, which contain a yellow pigment. Cells in the fourth layer are also thick walled.

(*To be Continued.*)

The American Postal Microscopical Club.

Operations in 1896 and 1897.

By R. H. WARD, M. D.,

TROY, N. Y.

[From Report of Management.]

THE MEMBERSHIP remains at about the average number of the last few years. Most of the Circuits are full and in good working order. There are, however, a few scattering vacancies where new members could be accommodated to advantage.

Since the last report the Club has lost by death several of the oldest and most faithful members:—T. B. Redding, Issac N. Himes, Geo. A. Rex, and J. C. House.

SLIDES AND NOTES—During a part of the season now closing, the supply of boxes reached the low-tide mark, necessitating the use of an exceptionally large proportion of the older and sometimes inferior boxes. Recent additions have restored an average supply, of more than average quality. Among the recent notable additions, the Club is indebted for gifts of fine special boxes from Professors Thos. D. Biscoe, Amos P. Brown, and Harry M. Kelly, Dr. D. B. Ward, and Mr. F. S. Morton; and for extra slides from Doctors W. H. Sylvester, and D. P. Frame, Professor N. H. Conser and Mr. Thos. J. Bray.

Besides the ordinary notes, which have often been carefully prepared and valuable, and which it is hoped will receive increasing attention from our members, a large number of special notes, giving a thorough study or demonstration of important subjects pertaining to various new slides have been, and are being, prepared by a few of the more experienced members—especially Vice-President Vorce, Secretary Shanks and the President.

NOTE BOOKS—To deface them with careless scribbling or to mar them in any way, as by stamping, folding,

unnecessary soiling, etc., is an imposition on the members and readers for months and years afterwards. A member lately entered this valuable suggestion: "What a pity to write such an interesting paper with such miserable ink. Let the Club adopt a rule that each member shall type-write his paper, or shall use good ink and the vertical handwriting." While, unfortunately, not all the members can write the "vertical" hand, which is far the best for the notes, any more than all can be required to buy a typewriter, whose work is still more legible, it is not too much to ask for good ink, and, it should be added the careful use of a good medium-fine pen that will give work which is legible and compact. The only ink really fit for use in the notes is the "waterproof drawing ink," bottles of which can be bought for twenty-five cents from the dealers in drawing instruments and supplies, which flows freely and evenly, gives a very distinct line, and, being indelible, will bear handling without smutting, and will therefore wear better than typewriter work or the best of common writing inks. The best-written notes by a very few of our members, are nearly as legible as typewriter printing, and far more compact and durable. Being of a very different consistency from ordinary inks, it should be thoroughly experimented with, using stiff fine pointed pens and not too much ink (thinned if necessary according to accompanying directions), until fine, uniformly good work can be done, before putting it to practical use. Higgins' "American India Ink, waterproof (white label)," is generally used by architects and engineers.

CO-OPERATION—It is a most suggestive fact that expressions of gratification are often made by able and cultivated people in regard to objects so common-place that a thoughtless person might be tempted to pass them by, unseen, with the superficial and flippant criticism that there was "nothing new in the box." This is worthy

of note as a reminder to the expert that many objects which are so familiar to him that he never thinks of offering them to the Club, are capable, with proper explanation, of being valuable to equally learned persons in different fields.

An object is named, not fully described by the label; and the most unpromising object may be valuable by reason of some peculiarity of structure, history or relations that can only be known by a careful view of the slide in connection with its note. Again, the most common slide may have a valuable note; some of the best notes ever in our books have been written to the most insignificant slides, and there are members who could make valuable any slide that could be found. If both slide and note be found weak, what better satisfaction can a member get than to make it useful to his neighbors by his own suggestions ?

CIRCULATION—Owing in great degree to the energy and devotion of our Secretary, Dr. S. G. Shanks, and the kind co-operation of the membership generally, the circulation has been, amidst almost unsurmountable difficulties, kept up to a fairly good average. During the season now closing, nearly every circuit will have received thirteen or fourteen boxes, and with as much regularity as possible under the circumstances.

Ovum in Testis of a Lamprey.

BY R. H. WARD, M. D.,

TROY, N. Y.

[Abstract of remarks at the Microscopical Section of the Troy Scientific Association.]

This slide of *Petromyzon* is a good anatomical study, showing the essential male organ, the testis, in a riotously active state, producing clouds of spermatozoa; and also showing the characteristic ovum of the vertebrate ani-

mals, which is normally, though not here, the product of the essential female organ, the ovary. But the anomalous origin of this particular ovum makes it one of the most interesting specimens that could be seen under the microscope. It also possesses, along with the interest of a rarity and anomaly, the far greater philosophical interest which always pertains to the beginning of things. This production of one single microscopic ovum by an elaborate gland that naturally, and here, but for this exception, is devoted to a different and incompatible performance, is a simple, uncomplicated first step in a line of evolution, the first link in one of those "nature's chains," about which we hear so much irrelevant and unreasonable talk. It is the first unit toward the growth of an ovarian body, or rather it is itself an absolutely simple ovarian body, combined with a testis, and the first beginning of the development of a perfect ovary in the place of one of the testes. This is equally true whether we regard the transition from testis to ovary to be an advance to a higher or a degeneration to a lower type. The latter, however, is probably true, since the testis is not only further removed in structure from the primitive and simple types of growth, but is more artificial and elaborate in its function. Evidently the ovum and not the testis represents the multiplication of primitive organisms by subdivision before male organs were evolved and male functions established to render possible higher grades of progeny.

In the vegetable kingdom such anomalies as that on this slide often occur, and the transition is in the same direction as here, from male to female and not the reverse. Thus in the Indian corn, certain portions of one or more of the staminate spikes that constitute the tuft at the top of the stem sometimes produce ovaries instead of stamens, and ultimately present well-developed kernels of corn. Likewise among the willows it is the

staminate plant (tree) which reverts, abnormally producing stamens that have an ovary in combination, or that assume the pistil form altogether. Such stamens-ovaries were circulated, by the present writer, in the club boxes many years ago.

It is an interesting question whether in the case of our slide the element of nutrition can possibly be the determining agency, the food-supply in this particular lobule or sack being greater or less than usual, as the case may be, or otherwise better suited to the making of ova than of spermatozoa, and thus causing this strange growth. It will be noticed that the mother cells of spermatogenesis which in all the rest of this testis have abundantly performed their work and filled the cavities and canals with spermatozoa, and have themselves almost entirely disappeared, have in the lobule occupied by the ovum apparently suffered an arrest of development, and remain in the lobule which is otherwise comparatively empty of male products. Was the nourishment just here unsuited to them, or was it so appropriated by the ovum that enough was not left for them?

The scarcity of spermatozoa in the immediate neighborhood of this particular ovum seems to render its fertilization improbable; and the apparently exhausted stock of food-supply in its lobule, and the absence of congested blood vessels prepared to supply the rapidly increasing demand of a developing ovum, seems to imply that this ovule would have shriveled and disappeared from the field of activity of this organ. But an imperfect or partial development of an ovum might conceivably take place sometimes without fertilization, and might easily go far enough to demoralize an organ so little adapted to ovulation as the testis is. On the other hand, if by some extraordinary chance spermatozoa should be developed within access of such an ovum and fertilize it, why should not a (truly) "extra-uterine" pregnancy be established in the

male, which would equal in its character and consequences any of the miraculous freaks of nature that have ever been recorded or dreamed of? It is fortunate for the males of all kinds and degrees that such consequences are infinitely improbable, and that such development, if commenced, could not probably advance to any great extent, owing to lack of suitable arrangements for nutrition.

It is evident that this case is not an example of hermaphroditism, in its full sense of possessing in an effective form the organs of both sexes, and being able to perform by turns or simultaneously the functions of both; though this seems to have been the theory accepted by the ancients who coined this word to designate it, and who left many carefully elaborated representations in their art as to what they meant by it. They knew little or nothing of the anatomical difficulties and absurdities which it implied, any more than they, without knowledge of internal anatomy and physiology, realized the similar absurdities of their schemes, likewise founded on external form alone, of mermaids, centaurs, and the like. But it is an hermaphroditism, in its first inception and simplest conceivable form, in the more modern and reasonable sense of a commingling, more or less, of the structures peculiar to both sexes; and it is, again, a first step towards a complete and effective hermaphroditism, if that be possible.

The animal kingdom seems to have got, in the course of evolution, mostly beyond the primitive grade of hermaphroditism, which is still a prevalent policy in vegetation, where we find it generally but not universally present. Its very type is the presence of ovaries capable of reproduction, and stamens capable of fertilization, both on the same individual; and we find this throughout the range of complex individuality in the most familiar plants. In the single flower we find both fertilized and fertiliz-

ing organs commonly though not always present; and the same words might be said of the flower-cluster or "inflorescence," and of the whole "plant," whether it be the tiny herb or the greatest tree. In some of the lowest forms, where each plant is but a single cell, and where the simplest conceivable form, perhaps, of sexual reproduction takes place by one of the plants merging itself into and thereby fertilizing another (conjugation), the cells are similar under the microscope, and unless there is some difference of structure as yet unknown, it may be assumed that each one is hermaphroditic in its powers, being able to fertilize or be fertilized as the chance may occur. So in the slightly higher grade of filamentous algæ, where the cells are united in a line, not apparently for interchange of food or products; but for securing advantage of position by serving as stalk to each other, and to that important extent constituting a true organism, the functions of fertilization seem to be completely mixed. When the filaments are crowded during the season of fertilization, their various cells fertilize their neighbors or are fertilized by them, apparently at random; and unless there is a sexual difference of structure still invisible and unknown, these cells also must have hermaphroditic powers.

Microscopical Methods of Examination of Powdered Drugs and their Adulterants.

BY ALBERT SCHNEIDER, M. D.,

MINNEAPOLIS, MINN.

Recent applications of the microscope have opened a new field of work to the practicing pharmacist. Unfortunately, only a few of the colleges of pharmacy yet realize the importance of the microscopical study of powdered drugs. But in this age no one is worthy to be considered a leading pharmacist who is ignorant of it. It is now

possible for every druggist to determine whether or not he is dispensing unadulterated remedies. To detect adulterations should be regarded as a part of his duty.

The plea has been advanced that only a few can become sufficiently expert to do such work and that most men lack the required time. Now no advanced treatise upon pharmacognosy is necessary for the prosecution of this study. A pharmacist of average ability can in a comparatively short time become sufficiently familiar with vegetable histology and microscopical methods to do such work thoroughly. The one who advances such a plea as lack of time and of opportunity has surely no moral right to dispense medicines.

The more expert work must be left to investigators of high scientific training, and to those who possess the most desirable apparatus. But what is required for the work here proposed is only ordinary intelligence and average training, combined with application and a desire to be a credit to the profession. After a few months of self instruction, aided by the necessary apparatus and a reliable guide to vegetable histology and micro-chemistry any one can acquire a fair degree of proficiency.

The following suggestions as to equipment, methods and re-agents are especially intended for the benefit of those pharmacists who know practically nothing about micro-pharmacognosy.

Keep constantly in mind not to purchase a single piece of apparatus until it is actually needed. Only such apparatus and accessories as are required by the beginner in the study of powdered drugs, will be recommended herein. In getting an instrument the novice had best take the advice of some impartial and experienced microscopist.

In this country, the Bausch & Lomb Optical Co., of Rochester, N. Y., and Zentmeyer, of Philadelphia, Pa., are the leading manufacturers of microscopes and micro-

scopical supplies. In Europe, Watson, of London, Leitz of Wetzlar, and Zeiss of Jena stand about equal as to their merits but the Zeiss instruments are higher priced.

The Leitz instrument, best adapted for the use of the pharmacist is the new stand IIC., with the following accessories: eye-pieces II and IV, objectives 3 and 7, double nose-piece, Abbe condenser and iris diaphragm. It is fitted with a graduated draw-tube, plane and concave mirror, and adjustable substage. The price of a good instrument with accessories is about \$60.00.

Another indispensable accessory is an eye-piece micrometer, to be used in making measurements of tissues and tissue elements. This consists of a circular piece of glass set in a hard rubber ring. On it is a scale of 5 mm. ruled into 100 parts.

The following are more or less indispensable: 1. A good sharp razor for making hand sections. 2. A stage micrometer. This consists of a glass slide on which is a scale of 1 mm., ruled into 100 parts. This is required to determine the scale of measurement for the eye-piece micrometer. After the scale is determined no further use is had for this micrometer so one might be hired or borrowed. 3. A half dozen or more watch crystals. 4. Glass slides, with ground edges, and cover glasses. Two or three dozen of each will be enough for most purposes.

Other appliances, such as dissecting needles, section-lifters, pincers, compressors, etc., are convenient but not absolutely necessary.

For the mechanism, care and use of the microscope, see these details given in text-books, of which the following are recommended: 1. Rusby & Jelliffe's *Essentials of Vegetable Pharmacognosy*. 2. E. S. Bastin, *Laboratory Exercises in Botany*.

Part two of both these books treats of microscopical methods and vegetable histology; part one, of the gross

anatomy of plants. The book first named is better adapted to the needs of pharmacists. The Bausch & Lomb Optical Co. issue a small book on the mechanism, use and care of the microscope. V. A. Poulsen's *Botanical Micro-Chemistry*, translated by W. Trelease, is an excellent little work on micro-chemical reaction and chemical substances found in plants.

A considerable number of re-agents will be needed whose use will be indicated as occasion demands. Drug-gists will probably have most of them on hand. Staining, imbedding, and preparing permanent mounts, few pharmacists will care to know anything about.

Hæmoglobin and Its Derivatives.

BY A. J. BIGNEY,

MOORE'S HILL, INDIANA.

On subjecting a dilute solution of arterial blood to spectroscopic examination, certain parts of the spectrum of natural or artificial light will be absorbed.

The amount of this depends upon the degree of concentration of the blood; if a one per cent or two per cent solution be used, two narrow dark bands are seen in the orange-yellow between the Fraunhofer lines D and E, the one next to E being a wider, but not so deep a band as the one next to D. A little of the red is absorbed and the violet indigo, and a part of the blue. This is the spectrum of Oxy-Hæmoglobin.

If arterial blood or venous blood which has been shaken with air be treated with some reducing agent such as ammonium sulphide or alkaline iron sulphate with tartaric acid, a decided change occurs in the spectrum. Instead of two bands only one appears, which is between the two lines of Oxy-Hæmoglobin, and is much broader than either of the bands mentioned above. This is the spectrum of reduced Oxy-Hæmoglobin or simply Hæmoglobin.

METHÆMOGLOBIN.

The spectrum of Methæmoglobin is obtained by first preparing Oxy-Hæmoglobin crystals by treating dog's blood with ether and shaking it until it becomes laky, then allowing it to stand in a cool place for an hour or so, at which time a firm mass will be formed, due to the crystals. The mother liquid is separated from the crystals by filtering through muslin or linen, squeezing the mass so as to obtain the crystals in as pure a form as possible. The crystals are dissolved in distilled water and a dilute solution is examined with the spectroscope. The two bands of Oxy-Hæmoglobin appear. A few drops of potassium permanganate are added and the solution gently warmed. If sufficient time has elapsed for the oxidation of the Oxy Hæmoglobin, the two bands will have disappeared and instead a single band in the red near the line C between C and D. Nearly the entire spectrum is absorbed. Sometimes it is a little difficult to get this band, but if the oxidation has taken place it will be seen. In the experiment at hand I left the solution until the next day, before it would give the above result.

CARBON-MONOXIDE HÆMOGLOBIN.

If coal gas be passed through blood which has been defibrinated, it will assume a cherry-red color, the carbon-monoxide of the gas having driven off the oxygen of the Oxy-Hæmoglobin and taken its place. The reducing agents have no influence upon this new substance, it being more stable than Oxy-Hæmoglobin. The two absorption bands are nearer to E than in the Oxy-Hæmoglobin spectrum.

HÆMATIN.

The red corpuscles are composed of a proteid stroma and a brownish pigment which is called hæmatin. The iron is a part of the hæmatin. It can be obtained either as the acid hæmatin or the alkaline hæmatin.

In making the acid hæmatin, I took 100 cc. of 95 per cent alcohol and added 2cc. of sulphuric acid, and then 10 cc. of blood; the mixture was boiled for about an hour in a flask tube three or four feet long so that the vapor passing off would be condensed in upper part of the tube and flow back into the flask.

During this process a precipitate is formed which is acid hæmatin. The solution is filtered and the precipitate is dissolved in alcohol and then examined. Since the precipitate is soluble in alcohol, that which is obtained by filtering does not represent all the hæmatin, for a part would be dissolved while boiling. The spectrum has one broad band near C. Most of the remaining portion of the spectrum is also absorbed.

If 95 per cent alcohol be added to blood and a small quantity of caustic soda, a still different spectrum is obtained. This is the alkaline hæmatin spectrum. It is similar to the acid hæmatin except the dark band is near and often on D.

Announcement of the Toledo Meeting of The American Microscopical Society.

BY E. W. CLAYPOLE,

AKRON, OHIO.

The annual meeting will be held at Toledo, on August 5, 6, and 7. The Microscopical Society of that city have taken up the matter very cordially and intend to do their best to make the visit and the meeting both pleasant and profitable.

The members outside of Toledo are asked to do their part to secure the success of the meeting by their presence if practicable, or, if not, by sending contributions to be read. Short notes on methods of work, notices of observations, details of experiments are all of value and will be welcome.

There is an interesting field for the existence and activity of this society in this country and the recent advance of microscopical investigation all along the line has enlarged its scope for the worker. There is abundant material waiting to be worked over which can supply endless subjects for discussion. The demand for microscopical knowledge and proficiency in the medical practitioner at the present day is so great that few among the older members of the profession can keep pace with the requirements and one of the best methods of keeping in touch with the advance of the medical art on the part of the younger men is the maintenance of a connection with such a society. They can thereby become acquainted with methods, men, and learn from time to time in what direction and by whom their field of labor is being enlarged.

To the teacher, too, membership is invaluable. The peripatetic nature of the society which holds its meetings in different places year by year brings them within the reach of different sections of the country and so reduces to some the cost of attendance. Any one, man or woman, engaged in any line of teaching which involves the use of the microscope can pick up hints enough from those whom he, or she, will meet to repay a moderate expenditure. And in the present day a teacher in any such line who is not progressive will soon become a fossil.

Persons desirous of joining the society either as active workers or as learners are requested to send their names to the Secretary, Dr. Wm. C. Krauss, of Buffalo, N. Y., to Mr. Magnus Pflaum, of Pittsburgh, Pa., or to the President, Dr. E. W. Claypole, Akron, Ohio.

The subscription is two dollars yearly with an entrance fee of three dollars, in return for which a member is entitled to a copy of the proceedings containing the papers read at the annual meetings.

Analysis of the Raised Coast Period Clay.

By ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

The analysis of the raised coast period clay was made by Prof. B. Silliman and published by Prof. J. W. Bailey in a paper entitled: "Notice of some new localities of Infusoria, recent and fossil" (Amer. Jour. Sci. and Arts, 1844, Vol. XLVII, page 337). He examined the clay, blue clay, from New Haven, perhaps the same as the Quinipiac marshes, in which W. A. Terry has described the Diatoms. Being used as a fertilizer, an analysis was made. When magnified it is found to contain particles of quartz, hornblende and feldspar derived from the rock granite of the Green Mountains which were brought down when it was formed, in the glacial period. There were seen the following diatoms:

Actinocyclus senarius.

Coscinodiscus excentricus.

" *oculus-iridis.*

Cocconeis oceanica.

Dicladia ?

Eunotia westermanni.

Galionella (Melosira) sulcata.

Grammatophora oceanica.

Pinnularia perigrina.

" *lyra.*

" *didyma.*

These are all Naviculas now, for I quote Bailey's original list.

Raphoneis rhombus.

Tesselo catena.

Dictyocha speculum.

" *fibula.*

Spongiolians caput-sepertsensis.

The analysis was :

Silica.....	58,633
Alumina.....	30,563
Oxide of Iron.....	6,186
Carbonate of Lime.....	4,263
Magnesia.....	0,705
	100,350

So it is an aluminium and iron silicate. When we compare the analysis of this clay with other Infusorial clay, as at Richmond, Va., Monterey, Cal., etc., and with the diatom ooze of the Atlantic and Pacific oceans, they are found to be essentially the same. I should style it a good mineralogical species and should be disposed to name it Collonite, not crystalline of course but formed from the water, marine or peat, from which it was thrown down.

Microscope Slides of Vegetable Material for Use in Determinative Work.

BY JOHN S. WRIGHT,
INDIANAPOLIS, IND.

In the determination of plants it is frequently necessary, or at least desirable, to make examinations of various organs with the aid of a lens. Seed markings, glandular structures and many portions of the flower upon which determinations are partly based may be so minute as to necessitate slight magnification for satisfactory work. For example we have in the Euphorbias and Lobelias, many species in which the seeds are to the naked eye mere granules, but under a hand lens, their surfaces are seen to be decidedly marked with irregular ridges and pits, or are handsomely sculptured. Many leaves contain glandular structures or are covered with hairs or scales which can be best seen under the lens. In determining specimens on which such structures exist and are of value in classification, it is often desirable to compare them with like material from well determined herbarium specimens. Commonly the material for these

comparisons is dug out of or cut off the herbarium specimen as it is needed from time to time and placed loosely under the lens for examination, and after it has served the purpose of the moment is brushed aside and lost or at best preserved in packets upon the sheet with the specimen from which it was taken. This method is messy and eventually impairs the mounted specimens of an herbarium, and where there are many workers it is not economical of time. To avoid this is quite practicable through the preservation of all such materials dry in cells upon glass slips as opaque mounts for the microscope. The cells are built by gluing to the glass slips brass rings, and the specimens are enclosed by cementing to the top of this ring the ordinary circular cover glass. The method of building this form of cell was suggested by Dr. Griffiths some years ago and is quite familiar. A cell of this form will not accommodate leaves and some other plant structure as well as another form of cell, which is made by gluing a rectangular frame cut from cardboard to the glass slip. A cell of this construction will contain small leaves entire or the tip and basal portions of the larger leaves, which can be viewed from either side. A cell of this type must be enclosed by a rectangular cover-glass. A supply of slips upon which cells of various sizes have been built, may easily be kept on hand, and whenever it becomes necessary to remove from an herbarium specimen material for examination, it may be placed in a cell in manner best adapted for its display, labeled, and you have at once, at very small expense, a slide of vegetable material which will be ready for use at any future time; and, if such a collection of slides is properly classified and arranged, it forms a working adjunct to the herbarium of much value, and, besides, provides one constantly with available material for numbers of demonstrations in botanical work.

EDITORIAL.

Postal Club Notes.—We are indebted for many of the items in this issue to the report of the Club which is printed and circulated privately among its members. We could save the Club expense and gratify our subscribers by printing its entire report for it once a year or better two or three times per year.

John C. House, of Troy, N. Y., who died January 22, 1897, was a man of gentle and refined nature, quiet habits and agreeable manners, of good heart, good sense and good will, a gentleman of the old sort, whose presence was ever a pleasure and an aid to his friends. May we see more of his like, again! He was a business man of professional instincts, whose leisure time was largely spent, with evident pleasure, in microscopical and astronomical study. He was for ten years secretary of the Troy Scientific Association, his last public act being the attendance at the last annual meeting of the Association, and taking rough minutes of the meeting which was to have commenced his eleventh year of service, but which his sudden death prevented his writing out. He was a member of the Club for eleven years, and most of the time in charge of one of the home-circuits in Troy; and notwithstanding the feebleness of advanced age, he was was one of the most careful, trustworthy and efficient members. In the note book of the last box that reached him, the date of its receipt was carefully entered in his handwriting, though he lived not long enough to reach the three days' time at which he should, and would, have forwarded it.

MICROSCOPICAL APPARATUS.

An Oblique Light Illuminator.—When using light for illumination, oblique to the axis of the microscope, it is found that about 150 degrees is the best angle to put it at. Less than that does not bring out the fine markings on the *Pleurosigma angulata*, for instance, and more than that, is more than the objective can stand so that the color results.

But a simple and efficient oblique light illumination is desirable. It is made in the following manner: A piece of glass rod such as is used by chemists for stirring solutions, $\frac{1}{4}$ inch long and about $\frac{1}{8}$ inch thick is taken and the round side ground down on a whetstone so that the ground part is rather fine. This can be accomplished by using a whetstone with a fine grain. The rod is ground down about one-third—about two-thirds are left. We have then a lens with parallel sides. It is cemented, the ground side uppermost by means of a solution of Gum Thus in alcohol and colored blue to a glass slide. The blue is imparted to it by means of a blue dye such as is sold by chemists and is an aniline dye. It is used downwards, the object glass to be viewed is placed above it and wet between them by means of Oil of Cassia. This allows the light to pass through and at the same time alters the refractive angle so that an oblique ray can enter. At the same time the light is colored blue, a color that is pleasant to the eye and at the same time objects seen in it can be seen with distinctness owing to the peculiar color. The light is a kerosine lamp and the mirror is a concave one placed at an angle of 150 degrees to axis of the microscope. I find this illumination is very practical and brings out the markings on fine lined objects or "beaded diatoms" nicely. It is easy to make. If tried by some reader will he let the results be reported? — A. M. Edwards, M. D.

MICROSCOPICAL MANIPULATION.

Bacillus of Diphtheria.—In examination of stained bacteria, use all the illumination you can obtain. Sunlight is best. Use Abbe condenser without a diaphragm, or with the largest opening of an iris diaphragm. A 1-12 oil immersion is necessary to clearly distinguish.

No objective yet made will bear this treatment and give critical image.

Gummy Media.—I once made some very satisfactory mounts of Algae, etc., in peach tree gum dissolved, or,

more properly, softened in acetic acid. I think there is a fine field for experiment, for anyone who has the time in devising an aqueousgummy medium, applicable especially to unstained vegetable mounts. C. M. VORCE.

Molasses as an ingredient of the Cell was formerly used to prevent cracking; but it proved a mistake which caused the loss of many fine slides, as in all cases black spots appeared sooner or later.

The best cell I know of for balsam mounts is made of Le Page's glue and some insoluble water color. They dry in an hour or two after being made, and will hold forever.

D. B. WARD.

Are the very small black particles that form these spots evolved from the chemical constituents of the molasses, or are they from the bone-black filters used in its manufacture? LePage's glue is probably glue or gelatin dissolved in a strong solution of borax, and, if covered externally with a good water-proof finish, it would seem to be permanent. S. G. S.

BACTERIOLOGY.

Fossil Bacteria.—M. B. Renault has long worked at the identification of bacteria found in geological strata, and now publishes the general results of his observations in a paper illustrated with a large number of drawings. As might be expected from their simple structure, bacteria appear to have been coeval with the first appearance of organic life on the earth, the coccoid form being apparently earlier than the bacillar. Indications of their presence are found in bone, teeth, scales, and coprolites, as well as abundantly in vegetable tissues. Spores and sporanges of ferns appear to have been especially subject to their attacks. The species are, as a rule, distinct from those at present in existence.—Ann. des Sciences Naturelles.

Bacterial Diseases of Plants.—Dr. V. Peglion describes in Malpighia a disease which attacks the stem of the hemp, causing disintegration of the tissues. It appears to

be produced by an organism of the nature of a bacillus embedded in mucilage, and very closely resembling *B. cuboniana*, a parasite of the mulberry. In Bulletin, No. 12, for 1896, of the Division of Vegetable Physiology of the U. S. Department of Agriculture, Mr. E. F. Smith states that several species of *Solanaceæ*—the potato, tomato, and egg-plant, *Solanum melongena*,—are attacked by a disease which he calls “brown rot,” due to a hitherto undescribed parasite, which he names *Bacillus solanacearum*. It closely resembles *B. tracheiphilus* and the form known as “Kramer’s bacillus,” but differs in several characters from both. In the *Revue Mycologique* for 1896 M. E. Roze has described several bacteria which cause diseases in the cultivated potato, viz., *Micrococcus nuclei*, *imperatoris*, *pellucidus*, *albidus*, and *flavidus*. He says that *M. pellucidus* is always found associated with the “scab.”

BIOLOGICAL NOTES.

Size of Stained Blood-Corpuscles.—My experience has been that human blood, or any non-nucleated blood, appears best when unstained. It may be an optical illusion, but I cannot escape the conclusion that staining reduces, in some manner, the size of the corpuscles.

When stained on the slide by the process of Dr. Moore, as these corpuscles were, there is no change of size produced by the staining. The coagulable matter of the blood and of the corpuscles becomes fixed, so to speak, by the drying process, and while permeable to aqueous fluids does not swell up, nor does it, on the subsequent drying, contract beyond its original dimensions when first dried. I have tested this by many measurements, and while there is sometimes a minute variance in the measurements, it is no greater than ordinarily occurs in successive measurements of the same corpuscle, stained or unstained. Dr. Moore tested this by measuring dry corpuscles, then staining them and remeasuring the same corpuscles which were identified by their relation to certain marks on the slide. I have slides of blood, spread at a single sweep and

stained on one half of the smear, leaving the other half unstained, in which measurements of a given number of corpuscles, taken as they come, from each part, give identical results.

C. M. VORCE.

Crystals in Blood Corpuscles of Frog.—I have a slide prepared by the process of the late lamented Allen Y. Moore, M. D. The blood was spread on slide, and dried; flowed with aqueous sol. of eosin, and washed; flowed with aqueous sol. of methyl blue, and washed, dried, and mounted in balsam.

The blood of fishes, frogs, and perhaps other reptiles, often exhibits crystals apparently within the corpuscles when simply dried without staining. This has been noticed by many observers.

These elliptically formed crystals are not in the same plane as the corpuscles, and seem to be on the cover-glass. It is the custom of some to cleanse the covers in an acid solution, and then rinse in alcohol. If this was done, the cause of the crystals being there might be from an insufficient washing after the acid bath. If a few drops of a saturated solution of any of the salts in water be dropped into a little alcohol, the salt immediately crystallizes into individual crystals such as are seen in this mount. I have had slides showing crystallization in film so thin as to be seen only by polarized light, which I attributed to an insufficient washing after soaking in a cleansing bath of borax solution; and I believe that if they had been rinsed in alcohol it would have produced individual crystals and not a thin film.

THOS. J. BRAY.

Larvae of Clothes Moth.—These larvae are very small at first; the body is white and soft, and seems to need the protection of the tube or case which it builds from the woolen fibres cut small and cemented together. My specimens were taken from a fancy worsted crocheted mat, of no earthly use, and consequently somewhat neglected; the dyed wool as utilized by the insect makes a pleasing object. The six anterior feet of the larvae are strong and can drag the caterpillar and its case along in this fashion: the body

is thrust out ahead, and the case is dragged up to it and adheres by its roughness until the body can be again thrust forward about half its length, when the case is again "hitched" forward. The masticated wool may be seen in the intestine; the pieces are liberal in size, which seems to indicate a very robust digestible tract. A mass of stored up fat may be seen at the posterior extremity of the body. This worm is able to make muscle, fat, blood and moisture out of the dry wool fibres. S. G. S.

Bog Moss Leaves.—The bog mosses are widely distributed in cooler climates, being the chief source of peat and turf deposits. They keep moist for very long periods, preserving the water in the bogs when the surrounding country is completely dried up. The cells of the leaf are of two kinds: (1) narrow elongated cells filled with chlorophyll, the so-called ducts, and (2) large empty cells stiffened by spiral or annular thickenings, and perforated by large pores which communicate with the exterior. These large cells are called the utricles; they retain the water for a great length of time, and serve as homes for various worms, rotifers, amoebæ, etc., some of which may be seen in a slide. A. P. BROWN.

Statoblasts ("winter eggs") of Pectinatella.—These are not eggs, since they cannot be traced to a single cell. A statoblast is formed by the separation of a mass of cells within the tissue of the Bryozoan; this mass cannot be traced back to any one cell, hence it is not an egg, or a developing egg, but is to be regarded morphologically as a bud, an internal one to be sure, which surrounds itself with a thick double cellular coating, and passes the winter in this shape. The statement in most text-books that the statoblasts are parthenogenetic eggs has been absolutely disproved. If at the time when they are beginning to form, transverse sections be made, of the colony, these cell masses may be clearly made out in the funiculus, and the stages in their formation may be followed.

HENRY B. WARD.

The Water Mites (Hydrachnidae).—These aquatic

members of the order Acarina are easily secured and preserved either alive as aquarium objects which will prove very interesting with their brilliant colors, odd forms and lively dispositions, or preserved with a corrosive sublimate solution, or in a mixture of glycerine, 2 parts, absolute alcohol 1 part, 2 per cent acetic acid (glacial) 2 parts, and distilled water 3 parts.

The writer will gladly give any aid in this study to those requesting it, either through identifications, or hints about collecting and studying the group. He will also deem it a great favor if any observer who secures the specimens but does not care for them will forward them to his address; or, if desired, he will collect in other groups in exchange for water-mites. ROBT. H. WOLCOTT, Lincoln, Neb.

DIATOMS.

Diatoms from Redondo Beach.—The bed upon the Pacific coast, 18 miles south-west from Los Angeles, Cal., from which this deposit was obtained, occurs at points from Redondo northward to Monterey and possibly farther. It has not always been found as rich as this waif, nor as the deposit in situ at Redondo.

This bed may be considered the counterpart of the great fossil diatom bed buried beneath the Atlantic coastal plain from New Jersey southward. The geological age of the Atlantic bed is now well known to be Miocene. The age of the Pacific coastal bed the writer has not as yet been able satisfactorily to ascertain, but it is probably either Miocene or Pliocene. The Atlantic coastal diatom bed dips very slightly and regularly toward and under the ocean; the Pacific coastal bed has been disturbed and upheaved from its original position, and sometimes dips quite steeply and nearly vertically, though generally also toward the ocean it borders. LEWIS WOOLMAN.

Distribution of Diatoms.—Diatoms are found in both marine and fresh waters, the specific forms being mainly different in each. Both marine and fresh water diatoms occur in the fossil state. They frequently form a consid-

erable component part of beds of great thickness in past ages. Beneath the Atlantic coastal plain there has been continuously traced a marine Miocene bed from Asbury Park, N. J., to Richmond and Petersburg, Va. It outcrops along the deeply-cut creek banks about Richmond, and underlies the town. It occurs between the depths of 16 and 95 feet at Asbury Park, between the depths of 400 and 700 feet at Atlantic City, N. J., and between the depth of 400 and 800 feet at Crisfield, Md. Its maximum thickness, so far as yet known, is therefore 300 to 400 feet. At Richmond, however, it is but about 25 feet thick.

A fresh water deposit, of Pliocene age, underlies the Llano Estacado or Staked Plains of Texas, an area several times larger than Pennsylvania. LEWIS WOOLMAN.

MICROSCOPICAL NOTES.

Crystals from Muller's Fluid.—As an object for the study of embryology, this slide [of fetal tissues hardened in Muller's fluid, and mounted through clove oil into benzole-balsam] is good; but look at it with your polariscope and tell the rest of us what these beautiful crystals are, which stud the entire surface of the mount. They evidently do not belong to the fetal hand, for they are diffused throughout the mounting fluid. If the preparer, after hardening in Muller's fluid, omitted to wash out the bichromate of potash from his object, these needles are bichromate of potash crystals. They have a somewhat rhombic form, which is what would be expected.

H. M. F.

Sonorous Sand from Hawaii.—The present writer has recently received from Dr. Benj. Sharp, who, with Prof. Libbey, visited the Sandwich Islands during the summer and fall of 1893, some of this same sonorous sand. It was obtained from a dune facing the beach upon the island of Kauai. Geologically the island is the oldest of the group, having been first formed; it is the only one of the islands on which dunes occur. All of the islands are of volcanic origin.

This sand is mainly composed of minute worn fragments of molusks. In that received by the writer there occur a considerable number of foraminifera, some quite perfect but most of them much worn. On treating the sand to hydrochloric acid, so as to dissolve the calcareous material, about 1-25 of the original bulk remained. This remainder is evidently chiefly composed of small, worn, sand grains, derived from the volcanic rocks of the island; it contains a few, very few, marine diatoms.

Sands which emit sound when their particles are rubbed together, as when trod upon, are not infrequent, and are not confined to calcareous sands. The writer has noticed them in the siliceous sands on the beach between one and two miles south of Beach Haven, N. J. None of these sands emit sounds when wet; to do so they must always be dry. They are locally called by various names, as sonorous, sounding, barking, musical, and æolian sands. Alexis A. Julien has written an elaborate paper upon "Musical Sands."

LEWIS WOOLMAN.

Section of Chalcedony.—Silica, Si O_2 , occurs in nature mainly in two forms, (1) crystalline and anhydrous as quartz, and (2) amorphous and hydrous as opal. Chalcedony is generally described as a crypto-crystalline variety of quartz; that is to say, while it is essentially crystalline in structure, the individual crystals in the mass are too small to be distinguishable. It is usually found forming crusts and lining cavities or cracks in rock, and is a secondary mineral formed by the deposition of silica in successive layers, this taking place so rapidly that there is no opportunity for the formation of distinct crystals of quartz. No doubt in many cases the silica thus deposited is largely gelatinous when first precipitated, but a crystallization soon takes place, so that in the mineral as usually found there is not very much opal in proportion to the crystallized portion. The crystallization proceeds from centre in a radial manner, so that the surface takes an irregularly rounded form which is described as botryoidal or mammillary. Between these minute crystals there is generally

more or less opal or uncrystallized silica which contains water, so that analysis shows that chalcedony contains from 0.3 to 2.5 per cent or more of water.

In this section, when examined in polarized light, the needle-like radiating crystals of the quartz are seen to form circular areas, in which the successive layers of growth can be well seen. These areas represent in section the rounded elevations of the free surface. Each circular area is composed of a very great number of crystals, which give it the radial character. These areas interfere with each other more or less, but an examination of their concentric banding as seen with the polariscope enables one to trace out the different stages of the formation of the mineral. At the edges representing original free surfaces some well-formed crystals of quartz have developed and encrust the edge of the section. The same region shows the enclosure of foreign matter, giving a banded appearance in ordinary light. This is essentially the structure of agate, which is simply banded (and generally colored) chalcedony. Carnelian or sard is likewise a variety of chalcedony of a red or yellow color (not banded).

AMOS P. BROWN.

NEW PUBLICATIONS.

Biological lectures delivered at the Marine Laboratory at Wood's Holl. Ginn & Co., pp. 188; constitutes a very interesting volume.

Microscopic Internal Flaws inducing Fracture in Steel. By Thomas Andrews, F. R. S., F. C. S., M. Inst. C. E., etc. 8vo, pp. 52. (London: E. and F. N. Spon. 1896.)

A paper of considerable importance to Civil Engineers, reprinted from *Engineering*, on Microscopic Internal Flaws in Steel, Railway Locomotive and Straight Axles, Tyres, Rails, Steamship Propeller Shafts, and Propeller Crane Shafts, and other Shafts, Bridge Girder Plates, Ship Plates, and other Engineering Constructions of Steel. There are 30 micro. figures showing internal defects.

COLLECTING APPARATUS.

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Some Collecting Apparatus.

BY DR. E. V. DADAY,

BUDAPEST, HUNGARY.

WITH FRONTISPIECE.

If we take some water in a clean glass vessel from the body of a lake and examine it attentively, holding it towards the light, we shall find in most cases that there are in the water, although apparently quite clear, small bodies and living beings of molecular minuteness swimming about, each in its own way. There was a time, not very remote, when students of the microscopic world contented themselves with examining each drop of the water drawn from a lake, with a magnifying glass in order to find the small animals in it. By such a proceeding we are in most cases left to chance. It is mere luck if we find something in the water. The naturalist desirous of getting thoroughly acquainted with the microscopic fauna of a lake cannot stop at this point, but ought to recur to such expedients as will assure him of the absolute perfectness and success of his researches. He must provide himself with suitable implements and they are numerous. He must at the same time provide himself with the means of conservation. For collecting specimens of water-fauna, we make use of a net. Considering the extreme minuteness of those beings we have

to deal with, all these nets must consist of the finest silk-cloth, called miller-gauze, but they must be of different fineness, according to whether they are used for collecting on shore, in open space, at deeper levels or on the bottom of a lake.

The best and handiest implement for collecting from the shore is the rod-net, which we may easily construct

ourselves by taking a brass, or still better an iron, ring and sewing on a bag of the above mentioned gauze. Then look for a stick of fitting length, cut it at its end and fasten the ring by tying it with a string. But there are several other rod-nets, which are not only practical regarding their form, but also easily managed.

A rod net commonly used, is represented by fig. 1, A, and consists of two different parts, viz., the net (a) and the rod or handle (b).

The net hangs from a brass or iron circle, provided with a small copper-tube, perforated on two opposite sides.

The rod or handle consists of three copper barrels, which slide one into the other, each of which is 1 to 1½ metres in length. The upper barrel has on its end a cover, from the centre of which a perforated clasp projects, which fits exactly in the copper-tube of the net ring. Being able to lengthen and shorten this rod as one pleases, we are relieved from the need of carrying with us a pole or several shorter sticks. The clasp on the end of the thinner rod and the tenon of the ring enable us to fix the net easily, while a pin put through the two holes prevents its slipping from the rod.

Collecting with this apparatus is very simple. We fasten the net to the rod by aid of the tenon and then we pull out the sticks and begin to draw water as if we were using a spoon. The water by this means is strained. The greater proportion of the animals, and, if our net is sufficiently fine, even the smallest organisms are retained.

To bring home the gathered material.—For this purpose a collecting bowl or basin of china, fig. 1, C, or some other material, and having a large gullet, may be used. Having filled this bowl with water before beginning the operation the contents of the net are washed out at intervals. At the close of collecting, strain the whole contents of the bowl through the net and substitute the water in the bowl with alcohol or any other preservative liquid.

The material thus prepared is finally poured into a glass tube (fig. 1, B) to be closed by a cork. On a small label note with a pencil the place of collecting, the so-called habitat: the time of collecting, the month, day,

and eventually the hour. Then put the label to the material in the tube. It is necessary to lay stress on this in order to avoid confusing materials found in different places; we may easily expose ourselves to error if collecting from different localities or from different parts of a lake.

Another kind of rod-net, not less commonly used is represented in fig. 2. It differs from the other chiefly by the funnel-like form of its net which is not closed but open, so that a wide and thick-sided cylindrical or other glass may be tied to it with a thick string (a). According to this, its rod must be much stronger than
a. that of the former, because the water contained in the glass vessel is of considerable weight and therefore we employ instead of the pretty elastic copper-barrels, thick bamboo sticks or pine-poles, to which the net may be fastened in the same way as formerly described (b). The use of this contrivance is nearly identical with the former, the only difference consisting in that we are not obliged to fill the bowl with water. The glass untied from the net, encloses already the required quantity. But the frequent tying and untying of the glass renders the whole proceeding a little dull and tiresome in comparison with the other without glass-bottom.

If we want to collect in the open lake, a boat or any other water-vehicle being at our disposal and intending only to examine the upper layers of the water, we might use rod-nets; but if we have in view to collect from deeper layers we are obliged to use so-called drag nets.

The simplest drag-net is a bag of silk-tissue fastened to a brass or iron ring. The brim is provided with three ringlets at an equal distance, in order to attach the line to it (fig. 3.) If we are on the open lake, our net may be lowered unto the required depth and at the same time towed by the advancing boat. During this operation the water filling the net is strained, while the organisms in it are retained by the fine tissue and may be secured in the way formerly described. With this contrivance we are enabled, provided our line is sufficiently long, to reach the bottom of the lake and may even bring up mud from the bottom. If we have no boat at our disposal and still want to collect from parts which are a little distant from the shore, then we put some stones, or other heavy object into the bottom of the net, throw the latter into the water and endeavour to get the desired material by slowly pulling the net to the shore.

Another kind of drag-net is due to the Bohemian Biological Institution. It reminds us in its general outline of the former, but is still different in many respects. Like the former it possesses a brass or iron-ring with ringlets for tying on the line, but its bottom is open. Here a glass-vessel is to be fastened as mentioned in description of the rod-net. This net, judging from its shape, consists of two parts, viz., a larger cylindrical one and a smaller funnel-like one, separated by a hoop of reed, sewn in. In the middle of the cylindrical part is also a hoop of reed. (fig. 4.) These hoops lessen the specific weight of the apparatus. The Bohemian searchers employ still another, funnel-like, open net provided with a reed-hoop, which is put in the space of the larger net and is apt to prevent material already in the large net from being washed away by the water flowing back. This precaution is superfluous, though, if in dragging the net necessary care is taken and the required time is given to strain the water. This implement is applicable only

when we can transport ourselves to the open space of the lake and on account of the reed-hoops it may only be used for working at the surface of the water. The material collected is subject to the same treatment, the bottom glass being applied, removed and emptied—as in the case of rod-net described in the second figure. Its use is therefore not so advantageous and multifarious, as that of the simple bag-like drag net.

In its principles of construction the net used at the Biological Station of Plou, called the plancton net is the same, but there is not at its bottom any closed vessel. It is provided with a tap, so that its contents may be emptied into the bowl by turning the tap.

For collecting organisms living at the bottom of lakes and bringing up mud, I devised a bottom-net of which I give a design in fig. 5. The outer cylinder (a) is made of pretty narrow brass wire tissue. The bottom is either convex or flat. The brim is formed by a brass hoop of 2 cm. breadth, provided with rings for fastening the line. Besides there are three movable clasps on it.

The middle cylinder (b) is a bag of very narrow silk-cloth, sewn to a strong brass-hoop about 2 cm. in breadth. The bottom is of bag-like shape. There are three tendons standing out from the hoop, to prevent the net from sinking to the bottom or from sticking to the outer wire cylinder.

The inner cylinder (c) is made of wide meshed brass wire cloth. The bottom is closed like a bag. The brim is covered by a flat brass circle 2.5 cm. broad, and its outer circumference is a little larger than the inner one of the outer cylinder. There are three little screws placed at an equal distance one from the other, provided with eyes; when using the net, the clasps are hooked in the screws and the eyes then screwed down. The separating and uniting of the three nets is thus rendered possible.

Each cylinder of this apparatus has another function. The outer wire cylinder is a protecting case, preventing any damage to the net and ought therefore to consist of pretty fine cloth so as to resist branches of trees, and things covering the bottom of lakes. The middle cylinder of gauze is the real collecting net, which retains organisms or slime after staining the water. The inner cylinder is intended for keeping off larger objects which would be liable to injure the fine silk gauze. It affords only protection to the inside and consists therefore of pretty wide meshes, giving easy access to water and organisms.

When working with it, we unite the different cylinders. After this the apparatus is lowered into the lake by the pulling line fastened to the rings. Then slowly advancing the boat, we tow it a certain time, until it naturally fills with organisms and slime. Having drawn out the apparatus, we separate the cylinders, by loosening the screws and take out the gauze cylinder with the matter contained in it. The conservation is then carried out in the same way as formerly described, but if there be too much mud in the net, its greater part is removed by dipping the net several times into the water.

For investigating certain fauna I have devised another dredge, shown in fig. 6., consisting of two parts, the shutting cover and the net proper.

The shutting apparatus (a) is formed by a brass frame standing somewhat obliquely, with a wide semicircular mouth. It is closed by a trap door also of brass, which may be raised or lowered. There is a small ring in the middle of this trap door near its horizontal edge, to which a line is tied. On both sides of this suspension ring there are two brass sticks with knobs on their ends; these are fastened to the frame but are movable, so that they are raised when the trap is opened and lowered when the trap is closed, sliding in the holes which are

provided for them in the trap door. The under horizontal edge of the frame is provided with a scraping blade standing out and directed a little downward. This facilitates the penetration of the mud through the mouth of the frame into the net. Opposite to this and inside the net there is another brass plate called the weight plate on which weights are placed to increase the specific weight of the apparatus. These weights are required for maintaining the apparatus, when let down, in a verti-

cal position and thus they prevent the frame from lying down by its own weight. There is a strong ring on the semicircular part of the frame, to which the pulling-line for lifting and lowering the apparatus is fastened. Beside this there is a border of fine wire tissue round the frame to which the gauze is fixed.

The net (b) is conical; and consists of fine gauze. It is fastened to the border of wire tissue surrounding the backside of the frame.

The apparatus is carefully let down by the aid of the rope. At the same time the rope which is fastened to the

trap-door is also let down. The trap remains closed until the bottom is reached. When the apparatus has reached the required depth, then we pull the rope of the trap-door and thus open it; the tightness of the rope which before was loose will inform us of the success. Then we must give our boat a slow impulse and drag the net along as fig. 7 shows. The water with all its organisms and the mud tilled up by the scraper, will then fill the dredge. Before drawing out the net, we let loose the rope of the trap door, thus closing it; no other material can thereafter penetrate into the net. The exact closing of the trap is furthered by the two brass-sticks. According to their length they allow the opening of the trap only to a certain height, viz., to about 20-25° to the upper board of the frame not in a vertical position. Thus the closing of the trap-door is not only due to its own weight, but also to the pressure of the water. After drawing up the net, the trap door is opened, the net turned inside out and the material washed into the bowl. According to the directions already given, it is then put into the conserving liquid and finally into the cylindrical glass.

The attention of naturalists is called to a great advantage which this net possesses over the drag and bottom-nets hitherto described. It enables him to undertake the exact determination of species living in different levels of water. With this implement, the opening of its trap-door being under control, we may collect our material at depths corresponding to our desire and state exactly the presence and migration of such and such species. We may determine in which masses or swarms they occur, during the different parts of the day; even the hour and the different depths in which they wander.

We have also to equip ourselves with certain other necessary things. It is very convenient to use a hunter's pouch. In the place of the cartridges we put our glass tubes and in the pouch itself the bowl and smaller nets.

The material gathered from different parts of the lake by means of any of this apparatus ought to be conserved each in a different way. If only the outward habitat of the different animal species forms the object of our study, then it will usually be sufficient to put the material in alcohol of 30-50°. This proceeding leads to a satisfactory result only when we have to deal with animals of greater resistance, such as rotatoria, crustacea, nematoda and protozoa. On the contrary, animals with a soft body, as protozoa with a thin shell and tubellaria as well as those with a harder shell must, if we want to examine them anatomically, be treated with certain chemicals before placing them into alcohol. The treatment with sublimate gives in every respect good results. We pour a solution of sublimate over the material filtered out and into the water containing the material. By this means the animals are killed suddenly, but their texture is conserved to a certain degree. This being done, we filter the sublimate or water containing the sublimate and substitute alcohol first of 30°, then of 50° and finally of 70°.

Bacteriology of Influenza.

By J. D. WHITLEY, M. D.,

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A number of Bacteriologists have made careful researches during the extensive epidemic of 1890, 1891, and 1892. In 1892, a bacillus was discovered by Pfeiffer and by Canon of Berlin, which according to Sternberg, there is good reason to believe is the specific cause of the disease.

Pfeiffer infers that this bacillus is the specific cause of Influenza in man for the following reasons: First. They were found in all uncomplicated cases of Influenza examined, in the characteristic purulent bronchial secretion, often in absolutely pure cultures. They were fre-

quently situated in the protoplasm of the pus corpuscles. In fatal cases they were found to have penetrated from the bronchial tubes into the peribronchial tissue and even to the surface of the pleura, where in two cases they were found in pure cultures, in the purulent exudation.

Second. They were found only in cases of Influenza. Numerous control experiments proved their absence in ordinary bronchial catarrh, etc.

Third. The presence of the bacilli corresponded with the course of the disease, and they disappeared with the cessation of the purulent bronchial secretion.

During the past winter I have made a careful examination of the sputum in a number of cases of moderate severity and found a very constant form of bacteria which answers to the morphological description.

That the specific exciting cause of Influenza is organic in its true nature and also that the air constitutes the medium of its dissemination there can no longer be any doubt. There is also good reason to believe that an incubative stage covering a period of two or three days is necessary for the development of the disease. The microorganisms are introduced into the upper air passages, and here finding a lodgment, develop upon the epithelial cells where they occur in pure cultures; they are then drawn into the bronchiæ by inhalation giving rise to the characteristic sputum, the cough and expectoration following in many cases after the patient has recovered from the initial symptoms. In this type of the disease little else is shown by a microscopical examination than the above mentioned bacilli. But in the graver type the picture is quite different and the severity of the attack is evidently due to a mixed infection. Here we have evidence of a local disturbance by the great quantities of bronchial epithelia which are thrown off the round cells, are very abundant, and also columnar cells, and often red blood corpuscles. White pus cells are very numerous,

together with the streptococcus pyogenes aureus in almost pure cultures. The pneumococci are found in large groups in almost every examination of this type; and last, but not least, we find that formidable ally streptococcus pyogenes is very abundant. The significance of the last named microbe may be inferred if we are to believe that special virulence is added to other diseases by its presence, notably in diphtheria.

The bacteria are best prepared by the "Ziehl-Neelsen" method of staining as for tubercle bacilli, using the Loeffler methyl blue for back-ground but giving a more than usual exposure to the latter agent.

The indications for treatment are antiseptics, eliminants, anodynes, and tonics, with rest in bed. I am convinced that the disease may be aborted in many cases if seen early, by the following prescription:

Quinia sulph.....	grs. xx.
Pulvis doveri.....	grs. xx.
Pulvis capsici.....	grs. iiss.
Aconite Tinc.....	.5 minims.

M. Ft. Pills No. x. Divide. Signa. Take three at once on retiring at night (after taking a hot foot bath); take one every two hours the next day.

In the more advanced cases the treatment should begin with a laxative, followed by salol in three to five grain doses every three hours, preferably in a powder form. This controls the fever, relieves the aching, and is a good intestinal antiseptic. In the troublesome head pain relief may be obtained by spraying the nostrils with camenthol 10 per cent. Codeine acts well in suppressing inordinate coughs, and good results have followed inhalations of carbolic acid with a steam atomizer where the expectoration was very profuse. The mouth should be rinsed frequently and the throat gargled with a warm solution of formaldehyde 1 cup diluted one half with warm water,

or the alkaline antiseptic tablet of Dr. Carl Seiler, one dissolved in a teacup, half full of warm water.—Medical Fortnightly.

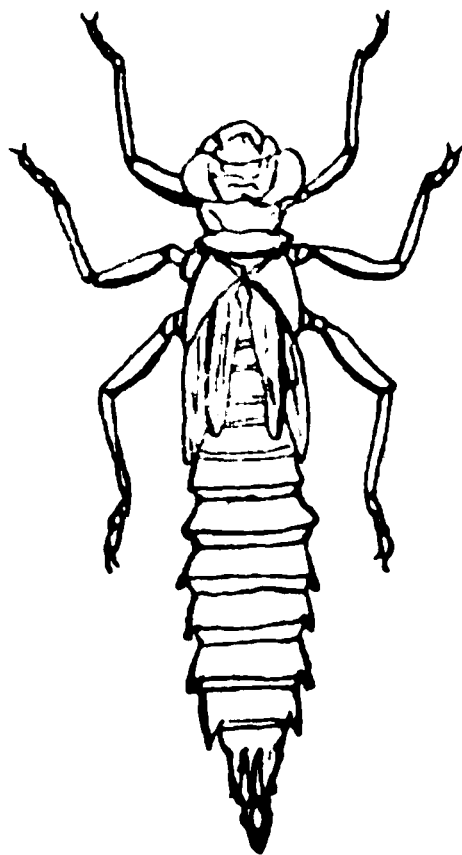
On Rearing Dragonflies.

By JAMES G. NEEDHAM,

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Field work in Entomology is full of delightful opportunities, and none is more inviting, none more sure to yield discoveries of scientific value, than work upon the life-histories of Dragonflies.

The nymphs which are aquatic, have an interesting distribution in depth. Those of Agrionidae and of most Aeschinidae cling to the floating or submerged vegetation. These at least every aquatic collector has seen. Those of Libellulidae sprawl upon the bottom amid fallen trash. Those of Gomphinae burrow shallowly along beneath the film of sediment that lies on the bottom, with the end of the abdomen turned up for respiration.



It is very easy to collect them. A garden rake with which to draw ashore the stuff to which they cling and a pail of water in which to carry them home is all the apparatus desirable in spring. Later when a new growth of weeds is rooted fast to the bottom, the rake will have to be exchanged for a water-net. Withdrawn from the water, the nymphs render themselves evident by their active efforts to get back, and need only to be picked up. The number of species one will find will generally depend on the variety of aquatic situations from which he collects. The places to yield the best collecting are

small permanent pools, shallow inlets in the shores of lakes, and the places where the trash falls in the eddies of streams.

They are quite as easily reared. Common wooden kits and pails half filled with water, with screen or netting covers are entirely satisfactory. A number of nymphs, if near one size, may safely be kept together (excepting only a few notoriously cannibalistic Aeschinidas: e. g. *Anax junius*), and if not grown may be fed upon such small insects as a net will gather in any pond. A good square meal once a week will keep them thriving. The water should be reasonably clean. Three things should be carefully observed. (1) There must be a surface up which they can climb to transform: if the sides of the kit are too smooth put in some sticks; (2) there must be room enough between the netting cover and the water for complete expansion of their wings: (3) they must remain out of doors where the sunshine will reach them. This last point especially is essential to success. But there is still an easier way to do it, and one which, when a species is very common, will prove entirely satisfactory. The several nymphal stages (excepting the youngest, not likely to be collected) are very much alike. I am in the habit of preserving the younger nymphs and putting into my kits only those well grown, as shown by the length of the wing-cases, which should reach the middle of the abdomen. But if, when a species is becoming common, one will go to the edge of the water it frequents, at the time of its emergence, one may find nymphs crawling from the water, others transforming, imagoes drying their wings, and others ready to fly, and may thus obtain in a few minutes the material necessary for determining nymph and imago. The time of emergence may be determined by noticing at what time pale young imagoes are seen taking their first flight, and then going out a little earlier. The unfortunate thing about it is that

many of the larger species transform very early in the morning, and to take such advantage of them one must be on the ground between daybreak and sunrise.

Several imagoes should be kept alive until they have assumed their mature colors. It is most important that each imago and its cast skin should be kept together.

Eggs, also, are easily obtained. Every collector has seen the female of some species, dipping the tip of her abdomen into the surface of the water, depositing eggs. If the ovipositing female be captured, held by the fore wings, leaving the hind wings free, and "dipped" by hand to the surface of clean water in a vial or a tumbler, an abundance of eggs will usually be liberated. Eggs of those species which possess an ovipositor and which place them within the tissues of plants may be obtained by collecting the stems in which they have been inserted.

Eggs and nymphs should be dropped in boiling water for a minute and then preserved in alcohol. Imagoes, if mounted, should have a wire or bristle inserted into the body its entire length to prevent otherwise certain breakage, or if placed unmounted in envelopes, these should be of soft paper, loosely packed, so that the eyes will not be crushed.

Try to cover for each species the points of the following outline regarding the imago :

- (1) Name ; locality ; date ; occurrence ; etc.
- (2) Haunts ; places frequented ; places avoided ; the reasons, if discoverable.
- (3) Flight : its hours ; its duration ; its directness ; average altitude ; places of rest ; altitudes.
- (4) Food : its kind ; how obtained ; where eaten.
- (5) Enemies : what they are ; and how do they destroy dragonflies ?
- (6) Oviposition : does the female oviposit alone or attended by the male.

(7) The eggs : where placed ; number in a place ; incubation period.

Regarding the nymphs, cover the points 1, 2, 4, and 5 of above, and Imagination : hours ; places ; distance from water ; etc.

It is very difficult to determine all these points for a single species, but the effort will lead on into delightful intimacy with these beautiful insects.

I will furnish (if desired) half a dozen named nymphs of typical genera to any one who will undertake to collect and rear others. I shall be very willing to determine nymphs or imagoes for any one, and to point out for description such as are new. But I especially desire that accurate field observations and notes be made on many of our species of which we now know only the names, and to such observers I will give all possible aid.—Can. Entomologist.

The Myometrium.—Bertelsmann writes regarding the microscopic relations of the myometrium in pathological enlargements of the uterus, with particular reference to the muscle cells. He has made (*Archiv fur Gynakologie*, Band L), a careful microscopic study of twenty-two enlarged uteri (three cases of mero-endometritis, four of carcinoma of the cervix, three multiple interstitial, and five submucous fibroid tumors). He comes to the following conclusions : Hypertrophy of the muscle-cells of the uterine wall is frequently associated with interstitial fibroids. Hypertrophy of the muscle-cells always occurs with submucous fibroids and in almost every instance where the uterine cavity contains an abnormal substance (pyometra and hematometra). Hyperplastic changes, also increase of the connective tissue and muscle-cells, were found particularly in metritis and in carcinoma and interstitial fibroids. These results correspond with those of Ritschl and Herczel, who experimented on the wall of the stomach and intestines by causing artificial stenosis and artificial irritation.

Hosts which Infusoria are Parasitic or Commensal.

Compiled from W. Seville Kent's Manual of the Infusoria.

BY THOMAS CRAIG, F. R. M. S.

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All marked * are parasitic IN their hosts, those not so marked are ON the host.

HOST	INFUSORIAN
<i>Carchesium polypinum</i>	<i>Podophrya carchesi</i>
* <i>Paramecium aurelia</i>	<i>Sphærophrya sol</i>
* <i>Stentor roeselii</i>	<i>Sphærophrya stentoria</i>
<i>Epistylus plicatilis</i>	<i>Urnula epistylidis</i>
" "	<i>Trichophrya epistylidis</i>
" "	<i>Podophrya quodripartata</i>
* <i>Cyclops quadricornis</i>	<i>Zoothamnium parasita</i>
" "	<i>Opercularia cylindratus</i>
" "	<i>Prodophrya cyclopus</i>
* <i>Cyclops gigas</i>	<i>Prodophrya infundibulifera</i>
* <i>Cyclops coronata</i>	<i>Ryncheta cyclopus</i>
* <i>Cyclops</i>	<i>Vorticella globularia</i>
* <i>Cyclope</i>	<i>Epistylis digitalis</i>
* <i>Canthocamptus minutus</i>	<i>Lagenophrys vaginocola</i>
<i>Entomostraca</i>	<i>Pyxidium cothurnoides</i>
"	<i>Zoothamnium affine</i>
"	" <i>parasita</i>
"	<i>Epistylis anastatica</i>
"	<i>Cothurnia imbertis</i>
"	" <i>sieboldii</i>
"	" <i>curva</i>
"	" <i>gracilis</i>
"	<i>Trichophrya digitata</i>
"	<i>Spirochona gemmipera</i>
"	<i>Spirochona scheutenii</i>
"	<i>Epistylis digitalis</i>
"	" <i>crassicollis</i>
<i>Gammarus pulex</i>	<i>Anoplophrya branchiarus</i>
" "	<i>Dendrocometes paradoxus</i>
" "	<i>Lagenophrys ampulla</i>
" "	" <i>nassa</i>
" "	<i>Spirochona gemmipera</i>
" "	<i>Epistylis steinii</i>
<i>Gammarus marinus</i>	<i>Spirochona scheutenii</i>
" "	<i>Stylochona coronata</i>
<i>Asellus aquaticus</i>	<i>Lagenophrys ampulla</i>
<i>Physa fontinalis</i>	<i>Schyphidia physarum</i>

Mollusca	Various opercularia
“	Conchophthirus anodontae
“	Epistylis coarctatae
Paludina vivipera	Podophrya elongata
Limnæus stagnalis	Epistylis plicatilis
Belanus	Epistylis balanorum
Unio crassus	Conchophthirus
Planorbis cornea	Epistylis euchlorum
Planorbis	Scyphidia limacina
Paludina	Phychostomum
Paludina	Anoplophrya vermicularia
Helix hortensis	Conchophthirus
*Mussel	Anoplophrya mytie
*Lumbricus terrestes (earthworm)	Plagiotoma lumbrici
“ “	Anoplophrya striata
“ “	Hoplitophrya lumbricus
“ “	“ falcifera
Lumbrichus variegatus	Hoplitophrya secans
“ “	“ securiformis
*Lumbricus limosus	Anoplophrya clavata
* “ tenuis	“ cochleariformis
A marine worm or annelid—	
Payrmobranchus protensus	Lichnophora cohnii
*Marine worms	Anoplophrya prolifera
“ “	Balantidium medusarum
Planarians	Trichodina digitodiscus
“	Urceolaria mitra
“	Colvoluta schulzie
“	Pulsatella convoluta
*Planarian limacina	Hoplitophrya recurva
* “ torva	Hoptophrya planiarium
“	“ uncinata
Planarian-thysanozoon tuberculata	Lichnophora anerbachii
Triton cristata	Spirochona tintinabulum
“ “	Trichodina pediculus
* “ toeniatus	Balantidium elongatum
*Bufo pantherinus	Haptophrya gigantea
*Hyla europea	Opalina obtrigona
*Frogs & toads	Opalina ranarum
“ “	Opalina dimidiata
“ “	Opalina intestinalis
“ “	Balantidium entozoon
“ “	“ elongatum
“ “	“ duodeni
“ “	Nictotherus cordiformis
*Nais serpentina	Anoplophrya naidos
*Nais littoralis	“ nodulata

Nais	Scyphidia inclinans
Bryozoa	Acineta pusilla
Nebalium bipes	Stylochona nebalina
*Clitellis arenarius	Anoplophrya filium
*Bombinator igneus	Opalina caudata
*Clepsine binocularis	Apoplophrya striata
*Pachydrilus verrucosa	Anoplophrya pachydrili
Hydrophilus piceus	Podophrya ferrum equinum
Neritina fluviatilis	Trichodina baltica
Sponge—freshwater	Cychochaeta spongilla
Cyclostoma	Trichodinopsis paradoxa
Tubifex rivulorum	Epistylis tubificis
Euchytroeus vermicularis	Hoplitophrya secans
*Urnatella gracilis	Anoplophrya socialis
*Medusa	Balantidium medusorum
*Human	Balantidium coli
*Moss on trees	Cyclidium arboreum
*Water beetles	Nictotherus gyseryanus
Hydroporus picipes	Podophrya wrzesniowski
Notenecta glauca	Acineta notenecta
Coleoptera aquatic	Podophrya leichtensteinii
“ “	Acineta linguifera
Insects	Nictotheras ovalis
“ aquatic	Rhabdostyla brevipes
“ “	Zoothamnium affine
“ “	Epistylis invaginatus
“ “	“ nymphaeum
Dytiscus marginalis	Pedophrya steinii
“ “	Opercularia articulata
Larva of culex pipiens	Epistylis umbellata
Tipula larva	Epistylis pyriformis
Phryganidæ larva	Podophrya phryganidarum
“ “	Epistylis brancheopyla
*Jules marginatus	Nyctotherus velox
*Dictoglossus pictus	Haptophrya gigantea
Succinea amphibia	Concophtheris
Fish	Trichodina scorpaena
“ trout	Ichthyophthirus
Porcellana platycheles (a crab)	Ophryodendron porcellanum
Caprella	Hemiphrya crustaceorum
Crustacea	Ophryodendron multicapitatum
Asellus aequaticus	Zoothamnium aselli
“ “	Opercularia stenostoma
“ “	Vorticella crassicaulis
“ “	Carchesium aselli
“ fluviatilis	Zoothamnium macrostylum
Astacus fluviatilis (cray fish)	Cothurnia sieboldii

<i>Astacus fluviatilis</i>	<i>Cothurnia astaci</i>
“ “	<i>Dendrosoma astaci</i>
“ “	<i>Podophrya astaci</i>
<i>Hydra</i>	<i>Kerona polyporum</i>
“	<i>Trichodina pediculus</i>
<i>Hydroids and polyzoa</i>	<i>Acineta livadiana</i>
<i>Hydrozoa</i>	<i>Ophryodendrum abietium</i>
<i>Sertularia</i>	<i>Podophrya lyngbii</i>
“	<i>Ephelota troid</i>
“	<i>Ophryodendrum abietinum</i>
“	<i>Hemiophrya microsoma</i>
“	<i>Ophryodendrum sertularia</i>
<i>Zoophytes</i>	<i>Acinetopsis rara</i>
<i>Clytia volubilis</i>	<i>Acineta crenata</i>
“ “	<i>Ophryodendrum belgicum</i>
<i>Plumularia setacea</i>	<i>Hemiophrya pusilla</i>
“	<i>Ophryodendron abietinum</i>
“	<i>Pedicellatum</i>
<i>*White ants</i>	<i>Trichonympha</i>
“	<i>Pyrosonema</i>
“	<i>Dynenympha</i>
<i>*Sheep and cattle</i>	<i>Isotricha</i>
“ “	<i>Ophryscolex purkinjei</i>
<i>*Swine</i>	<i>Balantidium coli</i>
<i>Soenuria variegata</i>	<i>Ptychostomum</i>
“ “	<i>Hoplitophrya pungens</i>
<i>*Pelobatus fuscus</i>	<i>Opalina intestinalis</i>
<i>*Phyllodoce</i>	<i>Anoplophrya ovata</i>
<i>*Cockroach</i>	<i>Nyctotheris ovalis</i>

A Camera Lucida for Use with both Eyes.

By ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

When using the camera lucidas, which are on the market, of course preference is given to that known as Abbe's and invented by Wollaston. Abbe's is not altogether satisfactory and Nachet's is better. But I have an instrument which can be used with both eyes at the same time which seems to be a novelty. And this one besides using both eyes was home-made so that its manufacture is extremely cheap. Besides, it has the novelty of being made by myself, and can readily be so made by anyone.

A brass cap is made to fit loosely over the eye-piece of the microscope so that it can be moved around and the camera pointed to any point of the compass. This is important as will be shown further on. Upon this is placed a prism of 30° . This can be obtained at any ordinary opticians. The prism is of ordinary crown glass and is rather large as purchased but out of it two or four prisms can be cut. I find it can be cut with a red hot poker placed upon it along the line which it is desired to cut. The cut surfaces can then be ground down with an ordinary hone with emery and water. This takes some time but is not essential. The microscope is placed in a slanting position which is advantageous, for the camera lucida can be placed upon the instrument without having to turn it over until it points transversely.

The object is viewed in the ordinary manner. Now when viewed through the camera lucida, the object seems to be moved towards the smallest side of the prism. That is to say the ray does not go through the instrument in a straight line but is bent toward the thin edge of the prism and in this way it seems to move the object out of the microscope to one side. When the left eye is used on the microscope the thick side of the prism is on the same side, i. e. the left. The object seems to be moved towards the right. It is there thrown down on a paper which is used to delineate it by means of a pencil. This pencil is seen by the right eye and in consequence of the two eyes being in use the object seen by left eye is transparent to the paper and seems to be where the pencil is. Of course such a camera lucida is not perfect. But it comes into play very often. And this was the shape I made it into.

I propose to use a plano-convex lens with the convex side uppermost where the right eye is placed and this will make it more certain. For if the lens is twelve or fifteen inches focus it can be used to see the pencil point

and also to fix the eye which has a liability to wander. I find in my case I can move one eye without the other, and this makes the image which is formed by the right eye move. Of course when the left eye is used to see the pencil point the prism can be reversed and sometimes it is useful to move it around from the east to the southeast. But these movements can be variable, as can be seen. I wish this camera could be tried, for it is easy to make and easy to use.

Brackish along with Fresh-water Bacillariaceæ.

BY ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

I have to record again living brackish Bacillariaceæ along with fresh water ones. And it occurred only a few days ago. One Sunday, in the latter part of June with a bottle in hand, for I never go without one, I was watching the turn of the tide at Bellville, N. J., near the bridge. I saw the water which was coming from a cut off where the *Myriophylum* and *Anacharis* was plenty, and snails, *Lymnea* and *Planorbis* in profusion had on the top a dust of Bacillariaceæ and other things. I saw it go down the river, which is brackish here until it passed to Newark bay and so to the ocean. I wondered what became of those fresh-water forms when they came to the salt water. Did they all dissolve or did they transform into salt-water forms? I got a bottle full of the water and brought it home and examined it and have it now growing in my window. There was a plenty of *Nitzschia obtusa*, var. *brevissima*, A. G., *Cyclotella striata*, *Eunotia monodon*, *Gomphonema turrio*, *Navicula cuspidata*, *Synedra ulna*, and various other fresh-water forms but there was living *Coscinodiscus excentricus* and *Surirella striatula*. Both of these are put down as brackish forms, but I had them here in fresh-water along with

a *Closterium*, a desmid, and more wonderful still a *Dictyodia fibula*, with endochrome in it. This is removed from the Diatoms and placed among the Rhizopoda.

Now what can become of these when they pass down to the sea? They may be dissolved, for they are readily soluble in fresh water and presumably in salt-water although they may not be as soluble. Or they may change. The *Surirella striatula* and *Coscinodiscus excentricus* may live as salt-water forms, for they have been seen so and the others die. The spot where I collected them was where the fresh-water flowed into the brackish, and Newark, which is only three miles further south, and where salt water is very brackish, and New York bay, which is nine miles further off is salt. So that we have a quick change from fresh to salt water and they can be watched.

EDITORIAL.

Small Attendance at the A. M. S.—We have just read in an exchange the query which the writer seems unable or unwilling to answer: "Why is it that the membership of the society and attendance at its meetings are so small?" The reasons are quite apparent but one hates to state them. The truth, if it must be told, is that a little group of officers and candidates for office run the meetings for certain very narrow, or for personal ends. There is never exhibited a broad spirit of philanthropy, never a sufficiently deliberate purpose to interest new recruits in microscopy, never sufficient means to enable them to learn the business, never reports from local societies, never steps to found additional local societies, never grants of money for philanthropic investigation with the instrument, never practical application of microscopy to hygiene, to health, to happiness of the masses.

A few specialists, a few college professors, a few doctors, get together to do what is of personal interest to themselves, to read accounts of what they have occupied themselves

about in the past, discuss such topics as vivisection, and the supposed right of all scientists to practice it without restriction or inspection. How can others feel much interest in such doings?

The conduct of the society as now run seems to be tinctured with selfinterest, and the devotion of one's time and thought to self leads to the alienation of others.

That bee-in-the-bonnet—to become F. R. M. S. and to be able to label one's name with those letters seems to overshadow the minds of the little group who go to the meetings, so that they are blind to what would interest a large number of people. This, if true, will sufficiently explain why so few join the company.

The greatly decreased number of local societies and the loss of interest in their work throughout the country has never given the American Society any concern. Never has it lent any aid to small and struggling societies, never has it asked after their welfare, never has it invited them to send delegates to its meetings. It does not even present them with copies of its Transactions. It leaves them all to get on as they may, and that has been for many years past towards decay.

Another thing the Society might have done and it never has done so. It might each year bring one of the world's great microscopists from Europe to deliver an address, and to advise regarding its work. The announcement in the periodicals, three months in advance, that Nelson or Dallinger, or Abbe will be present would mean that men will make efforts to attend who will not go to a mutual admiration circle. The money spent in publishing papers that were never read and absolutely verbatim reports of business discussions would suffice to bring one great guest to the meeting annually. All such papers could be published without cost to the society and the money now wasted be made useful.

In the last volume, one hundred and twenty-eight pages were occupied with eleven papers which were not read at the meeting, their authors were not present and very likely the papers were not completely written till after the meet-

ing. The thirteen papers which were read occupy one hundred and thirty-five pages. Why should people go hundreds of miles to the meeting to hear—

13 papers which will occupy 135 pages and to miss—

11 papers which will occupy 128 pages when every word uttered at the meeting will be sent out in type?

Notice this sample of wasted space :

“Secretary.—This completes the list, Mr. President.”

“President.—We are now under the head of ordinary business.”

“Secretary.—I wish to say that all members who have read papers and have not handed them in are requested to do so as soon as possible as I wish to have the Transactions out about the first of December, if possible, and surely before the holidays [Applause].”

The Proceedings were out the following June with “March, 1897” printed on the cover. By waiting, one may read every word and need not go to the meeting to hear anything.

There is probably not another society in the world that prints all this minutiae. It is a waste of money. The most successful societies now relegate all the business to secret meetings of an executive board. Who cares to go from New York to Toledo to hear the full society discuss the advisability of printing 400 copies of the constitution? The excuse for this printing is that not one in twenty of the members are present and that they must be informed of what goes on. Many of them pay their dues and if they do not get what is in the book, they get nothing therefor. But this in turn becomes a cause of small meetings.

Men do not like to confess their ambitions. If they did, we should probably hear from nearly all those who contribute to the Proceedings that they are candidates for the un-American English honor of F. R. M. S. The English society judges candidates by their technical publications and judges Americans by this volume in question. This fact is known by the members of this little group. Do not they act with this fact in view? And do they not largely forget and ignore matters of general interest or

utility in their desire to be successful candidates for F. R. M. S. If so, how can it be expected that the meetings will be large?

Each year the president of the society receives the long coveted honor. The records will show, that having gotten it, he usually graduates from all active connection with the Society. Annually relegate one of the most active members to obscurity and what should be the effect in the 19 years the society has been in existence? Do we need go further in order to answer why the attendance at the meetings is confined to a small group of people? If a man can get his paper before the Royal Microscopical Society by delivering it to the secretary of the American Society in time to go into the Proceedings why should he be to the time and expense of a trip to Toledo?

What then is necessary for the success of the Society?

1. Change its whole spirit and methods.
2. Elect only such men to the presidency as have largely advanced microscopical interest in America.
3. Pay the expenses of a distinguished microscopist to visit each meeting.
4. Transfer all business to secret sessions of a Board.
5. Publish only the results of business discussions.
6. Publish no paper that has not been read at a meeting.
7. Publish in full only such papers as are of great value and require expensive illustrations.
8. Publish brief abstracts of minor papers, leaving the periodicals to publish them in full.
9. Leave to periodicals all that properly belongs to journalism.
10. Permit and encourage the periodicals to publish all that they can of the papers read and of the president's address.
11. Be at work all the year preparing something that will interest a large number of people.
12. Take great interest in the welfare of the local societies and invent means to help them to prosper.
13. Receive their delegates as honorary members, entertain them and send them home full of enthusiasm.

14. Let alone and repudiate this un-American title F. R. M. S. and make F. A. M. S. an equal or superior honor, but let it be conferred only for philanthropic work done.

15. Meet only at central points within easy access of many members.

16. To double the membership, halve the cost of membership.

17. Treat the periodicals so fairly and liberally that they will work for the society all the time.

18. Banish narrowness, selfishness, cliques, cranks, unworthy ambitions and decide to become a power through the actual benefit conferred on the public.

19. For extremely technical papers which almost no one can understand substitute largely papers that educated people can see some meaning in.

20. Show continually the usefulness and application of the microscope to all branches of practical industry and the advancement of human happiness.

MICROSCOPICAL MANIPULATION.

Staining the Tubercle Bacillus in Sections.—This can easily be done by the methods recommended originally by Ehrlich and by Ziehl. Many slight modifications in technical details have been introduced by a large numbers of workers, but the essential step by which the *Bacillus tuberculosis* can be differentiated from other bacilli consists in the use of mineral acids, such as nitric or sulphuric acid. When bacilli have been well stained with methyl-violet or with fuchsin, it is found that certain dilutions of sulphuric acid and nitric acid will rapidly remove the stain from all known pathogenic bacilli, with the exception of the bacilli of tuberculosis and of leprosy, which are discolored very much more slowly. The use of nitric acid is, however, objectionable when one has to deal with delicate tissues, and even sulphuric acid, diluted with six parts of water, will cause a certain amount of distortion. For this reason bacteriologists have long wished to find a method in which the use of strong acids was done away with. Dr. Borrel,

after using a method in some researches in tuberculous lesion, has strongly recommended the following :

After the sections have been stained in the usual way by means of carbolised fuchsin, they are placed for a short time in a solution of hydrochlorate of aniline, and after this they are left in alcohol till quite decolorized, when it is found that though the fuchsin has been removed from all the tissues, the tubercle bacilli remain deeply stained.

This method, therefore, resembles very closely the Gram's method, with the difference that, instead of Gram's iodine solution being used to fix the stain in the bacilli, in this case it is Kuhne's hydrochlorate of aniline which is used.

Dr. Ratcliff, being engaged in delicate experiments on the spread of tuberculosis in the laboratory, was advised to try this method, which seemed to present many advantages over the older methods, when a few bacilli only are present in the organ. The details published not being quite sufficient to obtain very satisfactory results in every case, we worked out the details now given with the result that we can strongly recommend the following procedure:

- (1) Fix tissues by means of perchloride of mercury, acidulated or not, and then hardened in alcohol as usual.
- (2) Embed tissues in paraffin, using toluol as a solvent.
- (3) Fix section on slides by means of glycerine albumen in the usual way.

So far, there is nothing new in the method.

- (4) Stain with hæmatin solution for ten to twenty seconds to obtain a pure nuclear stain (not too deep); then wash thoroughly in water.

(5) Stain now with Ziehl's carbonized fuchsin, kept at a temperature of about 47 degrees C. for twenty to thirty minutes. The slides are during that time kept in a moist chamber to prevent the stain drying on the specimen.

(6) Remove the stain and treat the section with 2 per cent watery solution of hydrochlorate of aniline for a few seconds.

(7) Decolorize in 75 per cent alcohol till the section is

apparently free from stain; this will take from fifteen to thirty minutes.

(8) Double stain with a solution of orange (1 per cent of saturated watery solution of orange to 20 to 40 parts of 50 per cent alcohol).

(9) Dehydrate with absolute alcohol.

(10) Clear very rapidly with xylol.

(11) Mount in xylol and Canada balsam.

A New Method of Staining Nervous Tissue.—Vastarina-Cersi (Rif. Med., Feb. 14, 1896.) describes a new and effectual method of staining the spinal cord, etc., for macroscopic purposes. The entire cerebro-spinal axis, with the meninges, is plunged into about 3 litres of an aqueous solution of formaldehyde (16 per 1000). The tissue is left in the medium for two weeks, the meninges being removed on the second or third day. Sections from 3 to 5 cm. thick are then cut and kept in distilled water, or, better in alcohol at 40 degrees, for twelve or twenty-four hours; then plunged into 75 degrees solution of AqNO_3 in the dark. The white substance soon becomes stained brown. A prolonged stay in the AqNO_3 sol. does no harm. The stain may be fixed for an indefinite time if the preparation is left for two or three days in the dark in distilled water and then in alcohol at 70 degrees. Tissue so prepared shows in the clearest manner the relations between the white and the grey substance. For example, in the medulla one could distinctly see with the naked eye the respiratory fascicules of Krause. The advantages claimed by the author for this method are its simplicity and rapidity of execution, the constancy of the results, and its great teaching value.—Brit. Med. Journ.

BACTERIOLOGY.

Potato Agar.—Dr. H. M. Richards, of Barnard College, has proven the potato agar to be of great service. It is prepared as follows: Three or four medium-sized potatoes are washed, pared, cut into pieces and boiled in one liter

washed and again boiled one-half hour; the liquid is then filtered through cotton, then through paper, and serves as the watery basis of the agar. One per cent of peptone, $\frac{1}{2}$ per cent of salt and $1\frac{1}{4}$ per cent of agar are added to one liter of potato water and the whole boiled over a flame for about three quarters of an hour. The medium is then titrated to determine its reaction, and brought to react 0.15 acid phenolphthalein. If alkali (Na O H) or acid (H Cl) is added, the boiling is continued one-half hour longer. The medium is filtered through absorbent cotton sterilized for three consecutive days at twenty-four hour intervals, and then put into test tubes and sterilized. After the last sterilization the medium is allowed to harden on the slant.

MEDICAL MICROSCOPY.

Diagnosis of Pregnancy.—Dr. Park of Philadelphia reports that pregnancy may be diagnosed as early as twenty days after its occurrence by a study of the triple phosphates in the urine. The feathery appearance disappears from the tips of the crystals sometimes from one side only at first, followed by a like disappearance from the other side. If the fetus dies the normal appearance is renewed. This diagnosis of course affords the advantage that it can be made without suspicion on the part of the patient.—Am. Gyn. and Obst. Jour.

Examination of Blood in Diphtheria.—A microscopic examination of the blood will enable us to make a more intelligent diagnosis in diphtheria. If the myelocytes—i. e., mono-nuclear white blood corpuscles, with neutrophile granules (excluding both the mono-nuclear leucocytes poor in chromatin, considered by Frankel as characteristic of leukæmia, and also the large mono-nuclear eosinophile cells of Muller and Rieder)—are present in quantities of two per cent. or more in the blood of a diphtheria patient, the patient will die; but a smaller percentage does not of itself justify a favorable prognosis. The highest percentages found in diphtheria patients who re-

cover were 1.5 per cent., 1.4 per cent., and 1.3 per cent., and these were present only at the height of the illness, sinking back very shortly to 0.7 per cent., 0.1 per cent., and 0 per cent, respectively.

The maximum of myelocytes found in the blood of those who died of diphtheria was 16.4 per cent. On the other hand, eight cases died without any noticeable increase in the quantity of myelocytes. The author cannot yet state at what day of the illness a bad prognosis may be made, but in one case in which he was able to examine the blood on the fourth day he found 12.8 per cent. myelocytes. The first case died seven days later; the second, eighteen days after.

Interesting observations are recorded with regard to the numbers of other white cells, eosinophil cells, etc; but apparently no very definite conclusions can be formed with regard to them.

BIOLOGICAL NOTES.

Chalk.—A sheet of chalk more than 1,000 feet in thickness underlies all that portion of England which is situated to the southeast of a line crossing the island diagonally from the North Sea at Flamborough Head to the coast of the English Channel in Dorset. This massive sheet of chalk appears again in France and as far east as the Crimea and even in Central Asia beyond the sea of Aral. There can be little question that all these now isolated patches were once connected in a continuous sheet, which must, therefore, have occupied a superficial area about 3,000 miles long, by nearly 1,000 broad. These enormous deposits are made up of the microscopic remains of minute sea animals.

Hair on the Pulvill of Flies.—With regard to the difficulty respecting the hairs on the pulvilli of flies, is it to be expected that the hairs should be hollow, and in the nature of ducts for the viscid fluid secreted by the glands? Do they—the hairs—not act rather as a simple mechanical

method for enabling the insect instantaneously to detach its foothold from the object upon which it has been resting and supposing the pulvillus to be hairless, and the secreting surface to be brought into close connection with the object, would there not be great difficulty in the creature at once liberating itself ?

Action of Light on Fungi.—M. A. Lendner records (Ann. des Sci. Nat. Botan.) the result of a series of experiments on the effect of the access and withdrawal of light on a variety of fungi, chiefly mucorini and ascomycetes, grown on different media. All the mucorini examined developed sporanges under the influence of light when grown on solid substrata ; in liquid media the results varied with the species. In the case of the conidial forms of the ascomycetes, conids were invariably formed under the influence of alternate day and night ; under continuous light the results varied with the species. All the phenomena of heliotropic sensitiveness in fungi appear to have their source in the need for nutrition.

NEW PUBLICATIONS.

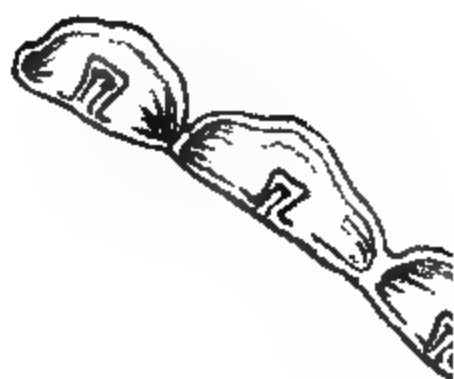
The Canadian Entomologist is a bright and newsy dollar magazine from which we extract items occasionally. The contributors are nearly all United States people, a recent number containing eight articles all from the states and none from Canada. The April number had seven U. S. contributions to three Dominion. How can Canada with only a few entomologists maintain such a magazine ? We suspect because cheap living makes cheap cost of printing while money and articles come from us to support the same.

Recent Articles.—F. Chapman writes in the May Geological Magazine on the Microscopic Contents of a sample of Bracklesham Clay from the Solent.

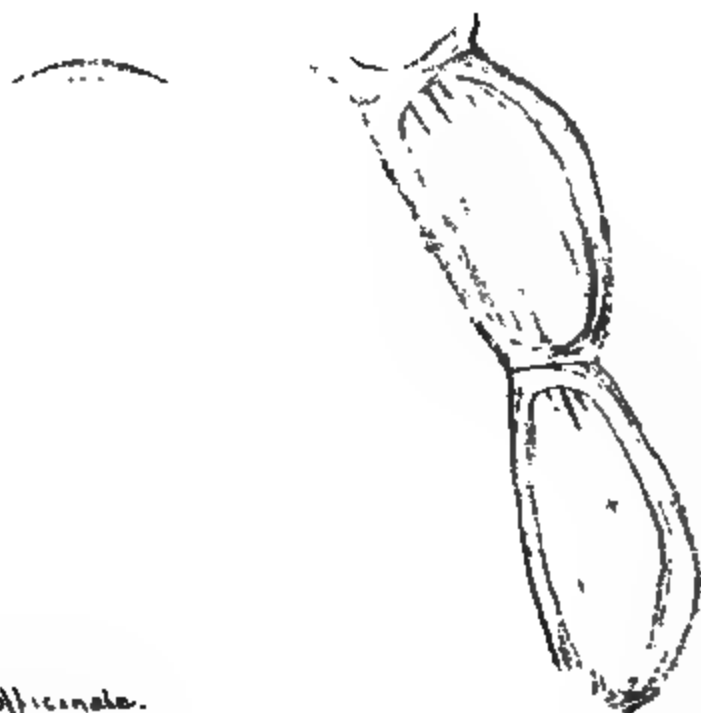
Prof. R. Jones describes in the same number some new Entomostraca from Brazil.



Siumbrum affigimur.



Capsella bursa-pastoris.



Siumbrum officinale.

SEEDS AND TESTA.

THE AMERICAN
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VOL. XVIII. SEPTEMBER, 1897. No. 9.

On the Seeds and Testa of Some Cruciferae.

By L. H. PAMMEL,

AMES, IOWA.

[Contributions, No. 6, Botanical Department, Iowa Agricultural College.]

WITH FRONTISPIECE.

Continued from page 210.

SISYMBRIUM OFFICINALE, SCOP.

Pod a half inch long or more, awl-shaped, somewhat four sided, borne on short erect pedicels, twelve seeded, seeds light brown, oblong, or in some cases, triangular, one half to three fourths of a line long. Caulicle extending lengthwise with a depression between it and the cotyledons. Cotyledons incumbent.

Seed coats quite uniformly developed. Cuticle covering the epidermal cells, the latter tabular, much compressed. On the addition of water the cell walls become mucilaginous with evident stratification. The second layer of cells brown and thin walled, much compressed. On addition of chloral hydrate they expand. Third layer much darker than the second, thick walled, followed by endosperm, cells elongated filled with protein grains, followed by elongated thick walled cells with a small cavity. These reach their highest development between cotyledons and caulicle. First row of cells of the embryo nearly isodiametric, filled with protein grains and oil.

S. ALTISSIMUM, L.

Slender, slightly curved pods, two to four inches long, firm, cylindrical. Seeds light straw colored, one-half to three-fourths line or less long; oblong or nearly triangular.

On the addition of water the cell-wall of outer seed coat becomes mucilaginous. Outer epidermal layer covered with cuticle, cells elongated, on the addition of water, walls become mucilaginous and show stratification. Cell-walls of second layer thick, light brown, followed by endosperm of two layers of cells, first elongated, thick-walled.

Cells of embryo as in *S. officinale*.

LEPIDIUM VIRGINICUM, L.

Pod orbicular or oval, a line and a half to one and three fourths lines long, larger than *L. apetalum*, with a small notch at the top, slightly margined above, often purple tinged at maturity. Seeds pendulous, light brown, minutely pitted, with a narrow winged margin, one line long. The caulicle runs lengthwise, on each side a groove, marking the boundary between the caulicle and cotyledons, the latter accumbent. On the addition of water the outer-walls become mucilaginous.

The seed coats consist of three well defined layers. The outer or epidermal cells are tabulated, somewhat compressed. The cuticle forms a continuous layer over these. On the addition of water the epidermal cells elongate and form a mucilaginous mass, showing stratified layers. These are not difficult to make out when the specimen is mounted in water. The cell cavity is very much reduced, that portion of the cell-wall in contact with the cell-cavity is differentiated from the outer cell-wall substance. Long continued addition of water causes the cuticle to break and the exterior becomes very irregular.

The second layer is colored brown, the cell-walls are considerably thickened laterally and project upwardly in the shape of cones. A section made through the ends of these seeds shows that the second layer is considerably more developed and there are evidences here of an indistinct layer between the first and second. The layer following this consists of thin walled parenchyma cells, in some cases considerably elongated but in others short.

The third layer is followed by the endosperm which consists of a layer of rather thick-walled parenchyma cells. These carry granular protein grains. This is followed by one or more layers of elongated cells, in which the cell cavity is very much reduced. These cells reach their highest development between the folds of the caulicle and cotyledon.

The Embryo:—The first layer of cells of the embryo are smaller, quite uniform in size and filled with protein grains and oil.

LEPIDIUM APETALUM, WILLD.

Pod a line and a quarter to a line and a half long smaller than Large Pepper grass, slightly notched at the apex, minutely pubescent.

Seeds pendulous, light brown, very slightly roughened and very narrow wing margined. Smaller than in *L. virginicum*, three quarters to nearly a line long. Caulicle extends lengthwise, with a prominent ridge as in *L. virginicum*, with a sharp groove between caulicle and cotyledons, the latter incumbent and flattened, a character which easily separates the species from the Large Pepper Grass.

The cuticle forms a continuous layer over the epidermal cells, the latter are larger than in *L. virginicum*. On the addition of water the cell wall rapidly elongates, emitting a copious mucilage, the cell-cavity is very much reduced but longer than in *L. virginicum*. It is sur-

rounded by a denser, more or less differentiated, part of the cell wall which is more yellow in color than the remainder of the cell-wall. The second layer is of a yellow straw color and consists of very minute cells with small cell cavities.

The cell walls of the third layer are strongly thickened brown and serve the same purpose as in the other species. The endosperm consists of thick walled parenchyma cells. In the first layer of cells the cell-walls are very much larger and packed with protein grains. The other layers of endosperm consist of small elongated thick walled cells with a small cell-cavity. These attain their greatest development between the caulicle and cotyledon. In the embryo, the cells of the first row are isodiametric filled with protein grains and oil. The outer cells are elongated, larger, and also densely packed with the same material.

CAPSELLA BURSA-PASTORIS, MORNCH.

Pods two to three lines long, two to two and a half lines wide above, some of the European specimens with larger pods, many seeded (8-22), seeds light brown, one half line long, nearly one fourth line in width, very minutely roughened. Caulicle elongated forming a ridge with slight depressions between it and the cotyledons. The latter incumbent. On the addition of water the outer seed coat becomes mucilaginous.

Microscopic Structure.—The seed coats attain their maximum development in the region of the caulicle. Cuticle covers the epidermal cells, the latter tabular, compressed but on the addition of water they elongate, become mucilaginous and show stratification.

The second and third layers are brown with thick cell-walls. Fourth layer consists of endosperm, one layer of isodiametric cells filled with protein grains, followed by thick walled cells reaching their greatest development

between the cotyledon and caulicle. First row of cells of embryo nearly isodiametric, filled with oil and protein grains. Others somewhat larger and contain the same substances. Cotyledons incumbent. Central part of of caulicle separated from the rest. Cells of caulicle very much larger than cells of cotyledons.

BARBAREA VULGARIS, R. Br.

Pods erect or slightly spreading, one half to three quarters of an inch long, somewhat quadrangular. Seeds blackish, a line or little more long, a single row in each cell, marginless. Cotyledons incumbent.

First layer of outer seed coat not well developed, cells elongated in the direction of the seed. Cuticle covers the epidermal cells. On addition of water a slight mucilaginous modification takes place. Second layer with thick lateral walls and quite large cell-cavities, colored brown. Third layer of rather thick-walled parenchyma cells also colored brown, followed by endosperm, as is usual in cruciferous seeds.

(To be continued.)

The Diagnosis of Malaria.

By ARTHUR R. EDWARDS, M. D.,

CHICAGO, ILL.

The diagnosis of malaria, like its pathogenesis, has a scientific life of scarcely two decades. The subject has been roughly handled since an acquaintance with its microscopic diagnostic methods has reached the general profession from the laboratories of scientific biologists and clinicians. Positive blood findings, i. e., the detection of the plasmodium of malaria, establishes the fact of malaria, since malaria is always caused by the parasite, and again the organism is always found in malaria and in malaria only. A few microscopic examinations will

convince the greatest skeptic. It must not be forgotten that, in certain instances, two diseases may occur simultaneously. We have seen malaria in conjunction with various ancient heart lesions, ulcerative endocarditis, pulmonary tuberculosis, chronic nephritis, although never with typhoid fever. The presence of malaria plasmodium makes possible positive differentiation from other diseases; e. g., the frequent error of overlooking or misinterpreting an incipient pulmonary tuberculosis attended with chills. Negative blood findings, in suspected malaria, are not definitive from one examination. Not infrequently is more than one microscopic search necessary for the positive exclusion of malaria. While suggestive, then, a single negative finding is far from conclusive. The parasites may be indistinguishable in the first few days of the disease. In certain forms they swarm in internal organs, avoiding the peripheral circulation; and lastly, in chronic and recurrent types they are found with great difficulty.

Certain deformities in the red blood corpuscles are often mistaken for plasmodia, e. g. crenations, poikilocytosis and vacuole formation. Not only can the more intimate structure of the red blood discs retract, simulating plasmodia, but the exterior of the hemacyte is far more plastic than is commonly acknowledged, even to the extent of protruding pronounced pseudopodia-like processes. These are but too frequently mistaken for parasites, being found in very many instances of apparently otherwise normal blood. Vacuole formations are characterized by their sharp contour and high luster.

Melainiferous leucocytes are readily distinguishable from the plasmodia by their large nuclei and by their amoeboid movement, always absent in adult parasites of equal size. Unstained spores may be confused with the blood plaques, which are, however, structureless and contain no pigment. An Austrian pediatricist lost a docent-

ship for reporting, as malaria, cases whose blood preparations afterward proved to contain only blood plates and no plasmodia. Coagulation products have been confused with flagella. Many of the small dots seen in malaria which resemble micrococci and were mistaken for such by the earlier Italian observers are similar to those found in most anemias and described by Ehrlich as degenerative changes.

TECHNIQUE.—Complex methods of staining and counterstaining the parasite have been in vogue, but the simplest and most accurate is the direct examination of the freshly-drawn unstained blood, a method we have used with entire satisfaction for several years. In this procedure injury to the corpuscles and staining of the blood plaques are obviated.

The lobe of the ear is cleansed, picked, and a quite small drop is gently expressed. A clean cover glass is held in a pair of forceps to avoid the heat and moisture of the hand, and is carefully brought in contact with the top of the drop. The heat and moisture of the hand or rudely placing the cover against the drop favor imperfect spreading from precipitate drying of parts of the blood. Rubbing the slide well facilitates equable spreading of the blood. Examination is best made with an oil one-twelfth inch immersion lens, although Laveran used lenses of lower magnification. Permanent preparations are procured by allowing the covers to dry, to remain half hour in equal parts of absolute alcohol and ether and by painting with filtered eosin and methylene blue. The use of stains is not usually advisable, since they obscure the otherwise more brilliant microscopical findings, they act as protoplasmic poisons, abolishing both the amoeboid movement of the parasite and the highly characteristic vibrations of its pigment, and finally, they stain the blood plates and coagulation produces, thereby confusing the findings, particularly for the unwary clinician.

THE TYPE.—Blood examination, however, demonstrates not merely the fact of malaria but also its types, since the various clinical forms of the disease correspond to 300 logically distinct, immutable species of parasite. Determination of species embraces more than purely biological interest; it declares also the prognosis, as in the pernicious forms, and designates the treatment, as arsenic in the tropical types. Councilman stated several years ago that in intermittent fever the parasite was seen within the red blood corpuscle, while in remittent fever or in malarial cachexia it was frequently seen without the same or in elongated forms and crescents. Crescents augur relapse. The presence of segmentation forms predict an imminent or incipient paroxysm. The alleged detection of the plasmodium is often doubted by us, since it is not uncommon to hear practitioners state that they have found Laveran's organisms, an error at least in species determination.

In general terms, the number of parasites found in the blood corresponds to the severity of the attack, although some believe the large spore-producing bodies remain largely in internal bodies.

MOTILITY.—In the ordinary tertian parasite there is lively amoeboid movement in the young and middle-aged forms. In the quartan form there is slight movement in the young parasite. In the aestivo-autumnal type it is variable, often very active.

PIGMENT.—In tertian malaria the pigment is pale and yellowish brown, is fine, and in the young forms is most active, or "swarming"; it accumulates towards the periphery of the parasite, in the pseudopodia protrudes, but in the older forms it becomes central. The pigment is inversely proportional in amount to the amoeboid movement, i. e., the more pigment the less the amoeboid movement.

In the quartan the pigment is coarse, being somewhat

larger than in the tertian, irregular, with but little if any movement. In the aestivo-autumnal form the pigment is active, although some describe it as slight, at first fine, later coarse, even rodlike.

SIZE.—The tertian is as large as the red blood disc, even larger; the quartan not larger than the red corpuscle, while the tropical forms are much smaller, from 1-5 to $\frac{2}{3}$ the size of the hemacyte.

PROTOPLASM OF THE PARASITE.—In the tertian it is pale and indistinct; in the quartan, sharply outlined, and of a characteristically high index of refraction; in the autumnal type it is ringlike, very small, hyaline, and difficult to detect.

ALTERATION IN THE RED BLOOD CELLS.—In the tertian the red blood cells hypertrophy, and are rapidly and completely decolorized. In the quartan they are but little decolorized, may be darker than normal, and are not essentially altered in size, although the corpuscle may become slightly smaller than normal. In the more pernicious types they are shrunken, become either darker, of "brassy" color, or completely decolorized, "shadow-like."

SPORULATION FORM.—In the tertian the spores are more or less irregularly grouped, individually small, round, whose nucleolus is seldom seen in unstained specimens, numbering 15 to 20 or somewhat less. The segmenting forms are about the size of a red disc, and are of irregular form. The segmenting bodies are found in the peripheral blood rarely, or in small numbers only, except at the time of a paroxysm. In quartan malaria the spores exist in the margarite form, spores being individually long, with distinct nucleolus, 6-12 in number. The segmenting forms are smaller than a red blood corpuscle, of a rosette form, are found in equal numbers in the peripheral and visceral circulations, and may be detected in the apyretic interval as well as in the paroxysms. In the

aestivo-autumnal types the spores are irregularly formed or stellate, six to eight in number, possibly more, and segmentation occurs chiefly in internal organs.

CRESCENTS AND FLAGELLA.—The crescents are found only in the aestivo-autumnal forms, and represent a very resistant form of the organism. They may exist for months at a time without fever or other symptoms. They may be converted into round bodies, from which flagellation is frequently observed. We have not seen crescents apart from extreme anemia. Persisting as they do we can scarcely consider them solely as degenerate forms; they impress us rather as resting stages. Flagella may be found in any type, though not frequently in quartan fevers. They may be seen when quinine has been previously given, and have been considered by some as degenerate forms. They are but rarely seen in freshly shed blood, but we have seldom missed them when examining a specimen for a long period, e. g. in clinic demonstrations.

INDIVIDUAL SYMPTOMS.—The diagnosis of individual or isolated cases is most intimately linked with the diagnosis by blood examination. Certain malarial symptoms are not only immediate sequences of the malarial infection but are also most beautifully explained by the life cycle, life activity and metabolism of the organism.

The melanemia corresponds with the structural disintegration of the hemoglobin of the red blood cells and its diffusion through the blood plasma. The anemia is secondary to reduction of the hemoglobin and diminution of the number of red blood corpuscles; in other words, to morphological hemodyscrasia. No leucocytosis is seen, save a transient apparent increase at the beginning of the paroxysm. The hemoglobin and red discs are destroyed in equal degree. The anemia is rapidly produced; in fact, corpuscular deglobulization is more rapid than in

any other acute affection, and can be utilized to differentiate from pneumonia or typhoid fever.

Each paroxysm being the ripening of a new generation of parasites, the fever corresponds to their sporulation and a saturation of the blood with toxins liberated from the red blood cells. It is a chemical hemodyscrasia, or, as Mannaberg aptly puts it, a "protozoan sepsis," analogous to that discharge into the blood stream of infective material observed in septico-pyemia.

We fully comprehend any clinical form of fever, when we realize that the fever is a toxic manifestation and that as often as the parasites segment, fever occurs. Hence two generations of tertian parasites cause quotidian fever, also caused by three generations of quartan parasites of unequal age. Quotidian continued fever accompanied by splenic tumor, the diazo-reaction, and even roseolæ or slow pulse, may cause difficulty in diagnosis from typhoid fever, especially as typhoid may be attended with chills and sweats. The blood examination speedily differentiates and Widal's serum test for typhoid is of great aid. The splenic tumor and bone pains are explained by the phagocytic process in their substance, the hemoglobinuria, diarrhea, retinæ and other hemorrhages by the toxemia, the cerebral symptoms, as coma, convulsions or bulbar symptoms, by aggregations of the parasite in the cerebral vessels with thrombosis.

Casts of Bacillaria from the London Clay.

By ARTHUR M. EDWARDS, M. D.,

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The London clay is lower Eocene resting on the Cretaceous and is below the Miocene Tertiary. The Eocene has not been examined in this and other countries for the diatoms in it but they are probably there.

Mr. W. S. Schrubsole sent me some specimens from the

London clay. It is from beneath the Red Crag which is called the older Pliocene. There is no Miocene, which belongs between these, and we expect to find the diatoms very different. The forms that exist in the Pliocene are about the same that grow now. The Pliocene diatoms of England have not been studied. Some Pliocene are enumerated in a paper on the Diatomaceous deposit of the mud of Milford Haven and other localities, by Fitzmaurice Okeden, in Vol. III, 1855. The celebrated Glenshira sand which is described in the same volume is most likely correlative with the Champlain clay, the Raised Coast Period of our shores, judging from the diatoms in it.

The London clay consists of a brown or bluish grey clay, containing layers of concretions called septaria,—“flattened nodules of calcareous clay, iron stone or other matter, internally divided into numerous angular compartments by articulating fissures which are usually filled with calcareous spar and show well against the darker matrix of the nodule.” Now that we know something about the power of calcareous matter to replace siliceous in organisms, for which we are indebted to the researches of Sollas, Hinde, Zittel, Hill and Jukes-Browne, we can reason as to what septaria are or were. Most likely they were siliceous sponges. One author thinks that “the reticulating fissures or septa (hence septaria) seem to have arisen from shrinkage of the mass while in the act of consolidation, and to have been subsequently filled by infiltration. Such argillaceous, calcareous, and ferruginous nodules are common in many clays and mails, as in the shale of the coal formations, in the Oxford clay, in the London and Barton clays. They are often arranged in lines and bands; are always more or less flattened; generally contain some central organic nucleus round which the matter has aggregated, such as a leaf, scale, coprolite or the like; and when split up in the direction of the

stratification, frequently exhibit very curiously marked sections. Hence the names; beetle stones, turtle stones, *Ludi helmontii* and the like. The fossil species of the Island of Sheppy indicate a much more tropical climate than the Eocene flora of France. The coast was sunk lower then and was warmer. The larger fossils are more tropical and the *Bacillaria* are more tropical. We find specimens of *Arachnoidiscus* there. It is comparatively a scarce form in that region. One specimen has been seen in England and one in Ireland. It is common in the Pacific states being brought to that coast by the Kura-Sigra or Janauss current from Japan where it is common also.

Cleaning the London clay carefully and viewing it by means of the microscope transparently, it is seen to contain sparsely certain discs that are black; and looking them over some will be seen semi-transparent and so fashioned as to show that they are diatoms. They were first *Coscinodiscus asteromphalus*,— little discs with hexagonal markings all over them. The London clay diatoms show the structure much more clearly than can usually be seen in transparent specimens. The cell membrane, which is colloid silica is removed and an internal cast of the cells shown. When they are viewed by front view they are seen to be curved outward on the interior and exterior, which is to say they are almost spherical. The specimen looks as if the disc consisted of a series of spherical balls set along side of one another. The material of which the black substance is composed is pyrite iron pyrites or sulphide of iron, formed by iron sulphate in the salt water in which the diatoms occurred acting on the organic matter of the diatoms, the protoplasm, which was decomposed, the oxygen being set free and the iron and sulphur thrown down as sulphide of iron. The diatoms can be seen when viewed with reflected light to be glistening, almost gold-colored, particles. A ring look-

ing like diatoms is seen which is most likely *Melosira sulcata* though the diatoms are in a stage that their specific nature cannot be made out clearly. There is also the *Coscinodiscus*, a cast of a *Triceratium* but the species is indistinguishable as the cast is opaque, lignite or pyrite. There is also a silicious shell of *Stephonopyxis turris*. The *Triceratium* looks like a cast of *T. undulatum* and perhaps should be placed there. Sometimes the change has taken place in the siliceous shells themselves. In that case the casts look like diatoms. Instead of being transparent they are made up of dark substance, lignite or pyrite, and the cavity with the lorica is not marked at all.

As *Bacillaria* are in the London clay and it is marine also we can carry the *Bacillaria* down to the lower Eocene in Geologic time.

Notes on Formalin.

By GEO. S. LIGGETT, M. D.,

OSWEGO, KANS.

Every microscopist should have some formalin on his work-table, especially the physician who uses a microscope. It will preserve specimens indefinitely and will harden a specimen so that an expert can make sections without any other preparation. I believe it will prove to be the most excellent preservative we have ever had. There is much to learn about it however.

Over a year ago I had a case of acute Hematuria. The urine seemed all blood. I had an eight-ounce specimen. After examining it and in order to keep it from decay I added some formalin. Next day I was surprised to find it coagulated. It has remained in that condition ever since. The bottle is nearly filled with a soft and dirty greyish coagula. In the bottom there is about an inch of a very hard and dark coagula. Examination of it now

shows in the soft coagula, red blood cells that look normal. I thrust a tube into the hard coagula and obtained a piece from which sections could be cut. It is a mass of blood cells. A few of them are normal in size and shape. The most of them are contracted and round and cupped. I have stained and mounted specimens that have been kept so long.

Not long ago when using some formalin that had been left in an open dish for several days, I noticed that there was a number of dead flies around. I wish some one who has had experience in using the vapor as a disinfectant by burning in these new lamps, would observe and report whether it will kill flies. To test the question further myself I put some formalin in a saucer-like dish, in which I had melted some paraffin and in which was quite a good deal of the paraffin remaining. I did not find many dead flies but I noticed another peculiarity of its action that may prove useful to some one who knows how to take advantage of it. I found the paraffin changed into a white friable powder. I heated some of it and found that it gave off fumes of formalin in great quantity. It will not melt like normal paraffin.

Bacteriological Researches Regarding an Epidemic of Horses now Prevalent in Canada.

BY DR. BENOIT, AND DR. PARIFEAU.

Some researches are being carried on in the laboratories of the hospital of Notre Dame regarding the nature of a contagious epidemic which is now prevailing among horses. The legs of the sick horses are covered with fistules which give birth, to an infectious suppuration.

The grooms who have to dress the sores of the sick animals are nearly all attacked on the arm or on the hands with an ulcer of inoculation, followed by ganglionic pains and hypertrophies in the small of the arms and in

the arm-pits. At the same time they show all the signs of a light general infection,—headache, insomnia, fever, chilliness and loss of appetite. It is stated that the horses are cured in about twelve days and they have no discharge from the nose neither any signs of pulmonary affection. Yet this disease was credited for some time to farcin for the examination of different specimens of pus from different horses, taken with precaution in sterilized pipettes have shown, under the microscope, the bacillus short, in little chains, in a clean space, characteristic of the glanders. But cultures upon gelatine and bouillon give only “staphylocoques dores purs.” It is a question then what this horse epidemic is.

The Physician and his Microscope.

BY A. A. YOUNG, M. D.,

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One of the most expensive and one of the most useless pieces of office furniture that the ordinary physician possesses is his microscope. It usually occupies a most commanding and conspicuous place in the office and decorated with “fuss and feathers;” valueless as an educator, valuable for the macroscopical appearances of the microscope, for it is capable of producing wonder and awe to the office visitor and shekels to the pocket of the physician.

Nothing can be said against the microscope as an instrument, for its value resides in its intelligent use, and unless used intelligently it becomes worse than useless, distorting facts and fancies alike, from which the observer can form no concept, can draw no conclusion save an erroneous one. The physician has to deal with the organic world, with those material forms in which resides that peculiar, unresolvable and unknowable agent we call life, and without which matter becomes comparatively valueless.

The microscope in the department of medicine requires for its intelligent manipulation a familiarity with anatomy, pathology, bacteriology, and last, but not least, biology, which subject scarcely ever enters into a medical college curriculum. We, as physicians, must deal with material forms that are endowed with life, and of that relation which exists between the material form and life we must have some concept, though it be partial and inadequate, for on the relation of things material or immaterial is the development of human thought possible. The life force of the bacillus is doubtless as intricate as the life force of the human subject and may be similar if not identical with it; for what is the body in which the ego resides more than an aggregation of amebæ specialized, and each ameba possibly having an independent life and having reproductive properties of its own. It is with the minute mass of matter, not the molecule, that the microscopist has to deal; he sees its manner and method of growth and not the forces which produce the molecular arrangement of the ultimate particles.

It is not enough that the physician be able to observe and differentiate the various forms of the micrococcus, spirillum or bacillus: he must know as well the habitat, manner and method of growth of each variety. Without this knowledge the revelations of the microscope are no more intelligible than some Egyptian inscriptions. There is a philosophy of microscopy which is equally as valuable as the facts on which it is based, but a philosophy that can only be developed by accurate observation and classification of microscopical data. This work, it is evident must be performed by the skilled microscopist and not by the novice, in which class the busy practitioner is usually found. In microscopical analysis no element relative to accuracy can with safety be omitted. It matters not though the microscopical accessories be thoroughly cleansed and sterilized, for the results would

be equally untrustworthy if the material to be examined be placed in a receptacle, found perhaps in some old garret and half cleansed. Conclusions reached under such conditions must be erroneous. Do you ask who ever allows such procedures? Go to the home of the amateur or pseudo-microscopist, observe his methods and technique and you will have the answer. It is surprising how much we see, how much we assume and how little we know. A young physician asks an older one for the use of his microscope to examine a specimen of urine, assuring its owner that he is familiar with the instrument, having had instruction in college; permission granted, and slide prepared, and the observer exclaims, "The most beautiful specimen of a cast I have ever seen;" the owner of the instrument says, "That looks like vegetable matter and not a cast." "No," said the other, "that is a urinary cast; I have seen many of them." A microscopical examination of the container and its contents revealed a corn cob for a cork; what the cast was you may readily infer.

A physician of several years' standing and the possessor of a good microscope at an autopsy of his announced that the patient's death was due to a disease of the kidneys, that she had been passing blood, pus, all forms of casts and other bad material with the urine. The autopsy, however, revealed ulceration with pus formation, degeneration and rupture of the gall-bladder, produced by impacted gall-stones, while the kidneys were practically normal, showing no structural degeneration. From whence, then, came the blood, pus, casts and debris, which was alleged to have been seen? These cases could have been none other than of mistaken identity; something was inferred that did not exist.

The conclusion is therefore reached, justly or otherwise, that the eye and understanding must be educated independently along certain lines before the manipulation of

the microscope becomes satisfactory and trustworthy; objects must be seen and known relatively and in their entirety before being resolved into their component elements: the macroscopical appearance of an object must precede its microscopical appearance.

The physician must know in what menstruum and under what conditions the objects for which he is searching exists or are developed. Neither is it enough for him to know and recognise the various forms of bacilli; he must be able to classify them and know their manner and method of growth, what they produce by their growth and what influence they have upon humanity. This is the philosophy of microscopy as relates to medical science. The microscope therefore becomes to the physician valuable in the degree that he is able to classify and arrange its revelations so that they may be read as from an open book. This faculty means a familiarity with the instrument born of time,—time which the “country doctor” must give by piecemeal, if at all.

I am no pessimist, although I see in a degree the passing of the microscope so far as it relates to the individual work of the ordinary medical practitioner. As already intimated, this passing is induced and sustained by unskilled and untrained eyes, which see much and individualize little.

The structure of microscopy, if it be enduring, must be built upon a comparatively errorless macroscopy. The rank and file still have to learn that the microscope only enables the investigator to continue his eyesight so as to observe the primary structure of an organised mass that would otherwise remain unknown and unknowable.

The first essential, then, for a physician microscopist is the proper use of his eyes, supplemented by a keen intellect; what he sees he must be able to describe accurately, thus differentiating the various forms and figures that appear in the visual field.

Neither is it enough for him to recognise an object in an isolated condition and know its form and construction : he must know as well what relation it sustains to other objects about it. This calls for the wise exercise of the comparative faculty, the second essential for the physician microscopist ; indeed, these two elements may be called his eyes. With these faculties undeveloped, untrained, he may as well be a blind microscopist. What is true of normal vision is pre-eminently true of aided vision, which aid the microscope is, but it produces changes also in the relative conditions of objects, and of such changes the mind must take cognisance ; it is an element too often overlooked. In short, the revelations of the microscope become the alphabet and the systematic arrangement of these revelations in the human mind forms its language, a language that requires study to comprehend ; a language also that needs much further development and amplification. Physicians, as a rule, can be novices only in microscopical science, following where others lead ; they stand at your feet, at the feet of the microscopists of the world, in the relation of pupil to teacher, asking for more light to illuminate the intricacies of human existence.

Give to them this light ; save for them the microscope with all of its powers and possibilities which are vast ; prevent it by your efforts from relapsing into a state of "innocuous desuetude."

Notes on Technique.

By PIERRE A. FISH, D. Sc.,

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In many of the modern articles, the methods by which certain pathological structures are demonstrated, if mentioned at all, are frequently so meager in the description of important details as to be practically useless to many

workers, unless a certain amount of their time is devoted to experimentation. A person, who has obtained fairly successful results with his older methods, is loath to forsake them, especially if his first few attempts with the new are failures. Each investigator may have certain laboratory conveniences; reagents of the best quality and dyes that have been well tested, all of which will enable him to obtain results much superior to his less fortunate colleague. It is difficult, therefore, to work successfully unless details are carefully attended to, and the reasons for the various steps understood. The methods following have been well tested, and have been attended with uniformly good results, which in some cases, it is believed, would have ended in failure with the older methods.

FIXATION.

The fixation of pathological tissues, with strong alcohol for histological study, is very commonly employed for the double purpose of killing at once any microorganism that may be present and at the same time to preserve the structure of the part. With many tissues this caused a too rapid withdrawal of the contained water or lymph, so that the specimen becomes hard and gives unsatisfactory results when it comes to the cutting process.

Some experiments with different reagents, upon known pathological material, were of service in formulating a mixture, which obviated the defects of strong alcohol when used alone. This mixture, while quickly killing the bacteria, also preserves most faithfully the histological structure. Various solutions of formalin, including the undiluted, were employed, and gave good results, particularly the presentation of the bacteria, after the usual staining methods. The tissues were more or less swollen by the weaker solutions, in marked contrast to the contraction caused by alcohol. Various combinations

of formalin with alcohol were also tried, and that which seemed to be most completely satisfactory for quick penetration and convenience, bacteriologically and histologically, was as follows:

95 per cent alcohol..... 100 parts.

Commercial formalin (40 per cent formic aldehyde). 10 parts.

Pieces of tissue, $\frac{1}{2}$ centimeter square, are well fixed in from twelve to twenty-four hours, after which it is well to leave for a few hours in 95 per cent alcohol before clarifying for the paraffin bath. Specimens, transferred directly from the fixing mixture, have been clarified in chloroform or cedar oil, but it requires a longer time.

The addition of the formalin is advantageous, because in a way it brings about a state of equilibrium. The alcohol alone shrinks the tissue while on the other hand formalin swells it, so that in this respect the one reacts against the other.

ADHESION TO THE SLIDE.

After the infiltration and imbedding of the tissue in paraffin, the question of the treatment of the sections is one of some importance. If they are to be carried through a series of reagents in watch glasses, and not placed upon the slide until they are mounted, the sections must necessarily be rather thick, in order to withstand the manipulation. Very much thinner sections, if adherent to the slide, and consequently supported by it, can be carried through the different steps of the process without injury, and show the structural elements to much better advantage.

The albumen or collodion adhesive, usually employed for this purpose, however, possesses the disadvantage of taking the aniline colors used in bacteriology; sufficiently to disfigure the preparations. If a clean slide be coated with a thin film of glycerine and then rubbed very nearly dry with a cloth or the hand, and a drop or two of 35 per

cent alcohol be placed upon it, the section, if curled, will tend to flatten itself when placed on the alcohol. If the slide now be placed in a thermostat for a few hours, at a temperature near the melting point of paraffin, the heat will cause any wrinkles or irregularities of the section to disappear; the alcohol slowly evaporates and when the slide is thoroughly dry the albumen molecules of the tissue adhere quite firmly to the slide, as noted by Gaule. After this the slide may be heated gently over a flame until the paraffin begins to melt. If any moisture remains the section will be quite likely to loosen during the latter stages. Thick sections do not adhere so firmly as thin ones. The slides may then be immersed in a jar of turpentine or any solvent of paraffin and carried through the various grades of alcohol to water.

A shorter method, in which there is as firm adhesion of the section to the slide, is to bring the slide in contact with aniline oil for a few minutes after the treatment with the turpentine, absorbing the superfluous turpentine with filter paper. The aniline oil is also removed by means of filter paper. The section is then thoroughly washed in distilled water which removes the oil, and the tissue is then stained and washed in water. If aniline stains are used, a hurried rinsing is sufficient. Drain or absorb the water and again apply the aniline oil. Besides clearing the section the oil tends to remove the aniline stain and care must be exercised in not letting this process go too far. Displace the aniline oil with xylol and mount in balsam. The color ought not to fade if the aniline oil has been thoroughly removed.

With certain stains, or combinations of them, the aniline oil may not succeed in preserving the sharp definition of the color. Under such conditions the section, after staining, may be treated directly with absolute alcohol to dehydrate and remove any superfluous stain. Some aniline dyes are not as soluble in absolute alcohol

as in the weaker grades. Clear in xylol and mount in balsam.

The use of aniline oil in the treatment of the sections will be recognised as having been recommended by Weigert for bacterial purposes. It likewise gives most excellent results in ordinary histological work and is a saving of time and material.

MOUNTING.

Many valuable specimens are ruined for the want of sufficient precaution in the preparation of the balsam. In its commercial state it contains many volatile principles and traces of acids, which, in the course of time, act upon the specimen and diminishes or entirely removes the color. All this may be lessened, if the balsam be heated sufficiently to drive off the volatile constituents, or more thoroughly obviated if a little potassium carbonate or mild alkali be added to neutralize the acid just before the balsam is heated. When the balsam becomes hard it can be broken into flakes and stored. When wanted for use dissolve in xylol to the desired consistency and filter through absorbent cotton. Specimens stained with the Biondi-Ehrlich mixture (which fades so easily) have at the end of a year shown no signs of losing their pristine clearness. *Trans. A. M. S.*

EDITORIAL.

Powders Identified by Pollen.—The Jour. of Pharmacology contains an interesting paper, by Mr. Chas. Pfister, on the pollen of some officinal herbs, his inquiry having been undertaken with the view of determining whether the powdered drugs could be recognized by means of any pollen which they may contain. Mr. Pfister's conclusion is that they can, and he submits figures and descriptions which corroborate his statement. Thus the pollen of horehound is squarish oblong, green and smooth; that of

worm-wood smooth, elliptical, and yellowish, some grains resembling a three-leaved clover. Mr. Pfister's notes do not profess to be exhaustive, but they are suggestive, and are worth following up. He mounted the pollen in sweet-almond oil, without previous preparation, and finished with a ring of gold size.

MICROSCOPICAL APPARATUS.

The Micromotoscope.—Dr. Robert L. Watkins says that living microscopic objects may be presented on a screen with an instrument which he calls a micromotoscope. After overcoming several obstacles he found it possible to do this directly by the use of a special arc light, but the one great obstacle—heat—dried the specimens so promptly that the living objects were killed and the method had to be abandoned. The appearance of the vitascope, however, suggested the possibility of applying some such method to the studies he was pursuing. This proved perfectly successful. By means of this instrument he discovered that the active motion of living microscopic objects could readily be photographed. By using from fifty to a hundred and fifty feet of the vitascopic film, and taking a series of impressions in sufficiently rapid succession, he has been able to secure pictures which when passed through a lantern at the same rate of speed will present on a screen all the motions of the objects photographed, and can be witnessed by an audience of any size.

Dr. Watkins thinks that the value of this discovery can not be overestimated, not only for use in studying the vital processes of microscopic life, but also as a method of teaching students and the public. In his investigations, this method has been applied more especially to the study of blood-corpuscles, and he states that the active motion of the leucocyte can thus be readily reproduced. It may be seen to stretch out its fingerlike prolongations and then retract them. The nucleus may also be seen to vary its shape, to split up into two or more, and sometimes the cell itself to divide into many parts.

The accurate reproduction of these various vital processes of cell life, he thinks, will be of great assistance in revealing the exact condition of the blood, and help us to get one step nearer the ultimate processes of life. Dr. Watkins does not hesitate to say that various cells now known by different names will be found to be only transition forms of the leucocyte. The amoeboid motion of the leucocyte continues sometimes for fully twenty-four hours after the blood is placed on the slide of the microscope.

There is another field of usefulness in which the micro-motoscope may prove of service, and that is in the study of the life of microbes in stale urine and other fermenting fluids, and in the study of the motile efforts of all microscopic germs and bacilli.

To secure an appearance of continuous motion, these pictures must be taken in rapid succession, allowing an exposure of from one fiftieth to one twenty-fifth of a second; and to complete a full cycle of motion, as in the expansion and contraction of a leucocyte, requires from eight hundred to fifteen hundred successive pictures. The time between the first and the second photographs is two minutes; the others are fifteen minutes apart; allowing an exposure of from one to two seconds. The impression made by their rapid passage before the eye when placed in a vitascope gives the sensation of continuous motion.

MICROSCOPICAL MANIPULATION.

Separation of Diatoms, etc., from Sand.—For this purpose we use certain liquids of high specific gravity, such as are used in minerological operations, and we commend the following:

BROWN'S LIQUID: Methylene iodine, which has a specific gravity of 3.3. By adding iodoform to this, this figure is raised to 3.45, while iodine increases it to 3.65.

KLEIN'S LIQUID: Potassium-boro-wolframin, the specific gravity of which is 3.28.

ROHRBACH'S LIQUID: Barium-mercury iodine, s. g., 3.58.

TOULET'S LIQUID: Sodium-mercury-iodide, s. g., 3.19.

Other liquids are: Silver iodide dissolved in concentrated solution of silver nitrate, which makes an oily, brown liquid of s. g., 5.00. Thallium-silver nitrate, melting at 75 C., s. g., 4.1. Concerning this last named chemical the Bayerische Industrie und Gewerbeblatt has the following information:

The specific gravity and the melting point of thallium-silver nitrite fall as the proportion of thallium nitrate is increased, thus, while the latter substance has a specific gravity of 5.00, and a melting point of 250, the addition of 1 part of silver nitrate to 4 parts of the thallium salt decreases the melting point to 200 degrees C., and the s. g., to 4.9. Three parts of silver nitrate to 4 parts of thallium nitrate bring the s. g. down to 4.7 and the melting point to 100 degrees C.

All the above are soluble in, or miscible with water in every proportion. In using them the material is thrown on the liquid, and floats or sinks according to its specific gravity.—*Zeitschrift fur Angewandte Mikroskopie*.

Pastes and Cements for Photographs and Other Purposes.—From a recent publication on the recent progress and novelties in photographic technique, by Eder and Valenta, the *Drogisten Zeitung* takes the following formulae for pastes:—

PASTES CONTAINING STARCH.

Gum arabic	4 parts.
Starch	3 parts.
Sugar	1 part.
Water sufficient.	

Dissolve the gum arabic in sufficient water to take up the starch; rub up together, add the sugar, and heat the whole on a water-bath until the starch is completely converted.

COLLODINE.—This is simply a paste made by treating starch with water rendered strongly alkaline, whereby the substance is rendered soluble.

TRITICINE.—This is a paste made of dextrin and starch in equal parts, in water, the starch being made soluble by

heat. A little glycerine is added to make the paste pliable and elastic when dry, and a little boric acid or thymol, or both, to prevent fermentation.

DEXTRIN PASTE—MUCILAGE.

1. Dextrin 50—90 parts.
- Alum 4 parts.
- Sugar 75 parts.
- Water 120 parts.
- Carbolic acid solution, 10 per cent. 60 parts.

Mix.

2. Gum arabic 4 parts.
- Water 8 parts.
- Glycerine 1 part.
- Neutral spirit. 3 parts.

Mix.

3. Gum arabic 70 parts.
- Water 200 parts.
- Aluminum sulphate 2 parts.

Dissolve the aluminum sulphate in a small portion of the water, and the gum arabic in the rest, and mix the solutions. This makes a very strong and excellent mucilage, the addition of the aluminum sulphate giving it great strength and adhesiveness.

PASTES CONTAINING GELATIN OR GLUE.

The following is recommended to the trade as a most "excellent paste for every possible purpose."

- Gelatin or best glue 2 parts.
Water6 parts.

Pour the water over the glue and let stand over night, or until the glue is swollen and soft throughout, then put on a water-bath and heat gently until the glue is melted. Add from 1 to 2 parts of chloral hydrate and let digest under gentle heat for some time. The resultant fluid is a liquid glue of great tenacity and keeping properties. Another formula is as follows:

- Best glue. 40 parts.
Water 100 parts.

Treat the glue as before, by letting stand over night and melting in the water-bath. In the hot liquid stir 40

parts of starch, a little at a time, with constant stirring, until the starch is converted. Then add 5 to 10 parts of oil of turpentine, and stir in. This glue should be warmed up till lukewarm before using. Finally, a very powerful cement is made as follows:

Cover 100 parts of gelatin with cold water, and let stand until the gelatin has absorbed as much of the water as it will take up. Pour off the residual water and get rid of the last traces of surplus by throwing the gelatin on coarse cloth. Melt in the water-bath as before and to the liquid add 150 parts of alcohol, 500 parts of water, 50 parts of glycerin and 20 parts of carbolic acid.

BACTERIOLOGY.

Bacillus Coli communis.—It has been known for many years that certain micro-organisms found in animal dejecta decomposed alkaline nitrates with formation of oxygen, which is utilized by the bacteria, free nitrogen, and liberation of the base. One of these organisms is the *Bacillus Coli communis*, and Hugounec & Doyon have recently presented a memoir on this subject at a meeting of the Paris Society of Biology. They find that by reversing a tube of a sterilized solution of potassium nitrate in peptone, sown with *Bacillus Coli* over a tube of mercury, that after some hours several cubic centimeters of nitrogen are liberated by the denitrifying action of the bacillus. The nitrate solution was found to be most strongly acted upon when containing about 1.5 per cent. On testing with Eberth's bacillus similar results were obtained.

Smegma Bacillus.—Grethe (*Fortschr. der Med.*, May, 1896) points out the need of some simple method of differentiating the smegma bacillus from the tubercle. The inability to distinguish between these two germs has led to serious results in a number of instances; in one case a supposed tubercular kidney was removed, but upon subsequent examination it was found that there was present only calculous pyelitis. In this case supposed tubercle bacilli were found in the urine. A number of other cases

have been reported in which similar errors have occurred.

Grethe has found that reliable results are obtained by staining with a concentrated alcoholic methylene blue. This stains the smegma bacillus well; and if the preparation be first stained in the ordinary manner with carbol fuchsin, the tubercle bacillus, if present, is easily identified by its red color contrasting with the blue of the rest of the preparation, including the smegma bacillus.

MEDICAL MICROSCOPY.

The Recognition of Diabetes by Examination of the Blood.—Bremer shows, in the *Journal der Pharmacie von Elsass-Lothringen*, how it may be effected by the aid of the microscope, in demonstrating the grape sugar reaction in that vital fluid. He says:

Mix equal volumes of saturated solutions of eosin and methylene blue and pour the mixture on a filter as soon as the precipitate ceases to fall. Collect the precipitate after washing on the filter, dry it carefully, and pulverize it very finely. To this powder add 24 parts of eosin and 6 parts of methylene blue, also in fine powder. This will make a redish-brown powder.

The blood to be examined is spread in a very thin layer over a cover-glass, another cover being smeared with a drop from some person known to be healthy, the latter serving for purposes of comparison.

After drying, put the two cover-glasses simultaneously in a mixture of alcohol and ether in equal parts, put over the waterbath and let boil for four minutes. Remove and put in a solution made by dissolving from 25 mgm. to 3 cgm. of the mixed powder described above in 10 gm. of 33 per cent alcohol (alcohol 1 part, distilled water 2 parts). This solution, we should remark, should be freshly prepared on each occasion that it is required.

Leave the cover in the stain for about four minutes, remove, rinse with water, and examine under the microscope. If diabetes be present in the person whose blood is under examination the latter will be colored a blue-

black, while normal blood, takes on a red-violet. In all cases where possible, for the sake of absolute certainty, the urine should be tested for glucose by any of the well-known reactions.

Yellow Fever Microbes.—Dr. Havelburg announces that the microbe which he considers the specific cause of yellow fever is found only in the stomach and intestines, but is cultivated by injecting it subcutaneously into guinea pigs. He finds that a previous injection of blood from a yellow fever convalescent renders an animal immune to an otherwise fatal dose of injection of the cultivated microbe. —O Brazil Medico.

MICROSCOPICAL SOCIETIES.

Quekett Microscopical Club.

The 352nd meeting of this club was held on June 18th. It was voted to alter rule 1 of the club's bye-laws making the vacation three months instead of two, as heretofore. Meetings will be resumed in October.

R. and J. Beck exhibited a portable binocular microscope with the stage and sub-stage entirely removable for convenience in packing. Mr. Nelson did not see why this arrangement should be less practical and rigid than the more complicated and expensive revolving movement usually employed. Mr. Nelson described the performance of Leitz's new semi-apochromatic 1—10th oil immersion objective of 1.3 N. A., which he thought was the finest lens yet produced at anything like the price—viz., \$18.00. He also exhibited one of his new-formula reflecting loupes, and a fine series of enlargements of his well-known photomicrographs of diatom structure. Mr. A. Earland read a paper on collecting Foraminiferous material, including directions for cleaning and mounting. Mr. Rousselet read a paper on the male of *Proales wernecki*—a rotifer the females of which produce galls on *Vaucheria*, in which they reside and deposit their eggs.

SEEDS AND TESTA.

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Public Water Supply for Small Towns.

By M. A. VEEDER, M. D.,

LYONS, N. Y.

Drinking water that is manifestly bad does not make everyone who uses it sick. Even when the mains and reservoirs of a public water-system have been infected by such a poison as that of typhoid it is only exceptionally and for limited periods that as many as one per cent of those using the water contract the disease. An outbreak of 2,000 cases in a population of 200,000 is ordinarily regarded as a severe epidemic, and yet this is at the rate of only one person in a hundred. It is this immunity on the part of the great mass of the people that permits infected systems of water-supply to continue in operation. If there were no resisting power on the part of the individual, all would die on the slightest exposure and the source of danger would be thoroughly identified and avoided. As it is, however, for every one that contracts the disease there may be as many as a hundred who escape. Thus it becomes a question of probabilities, and there is a chance for much plausible theorising and controversy. Gradually, however, as the result of increasing observation and experience, crude ideas that have prevailed are being eliminated and the truth of the matter established.

Only a few years ago the most essential point in the improvement of water-supply was thought to be the

determination of the chemical ingredients held in suspension or solution. Elaborate systems of analysis were devised for this purpose, and the quality of the water was judged almost entirely by its chemical reactions. Thus it becomes customary to consider the questions involved from a chemical point of view exclusively. The simple dilution of contained matters of a chemical nature if carried far enough, would make them harmless. Consequently large bodies of water were supposed to have a power of self-purification in direct proportion to their size. In like manner precipitation, sedimentation, aeration and other chemical and mechanical processes were supposed to have a purifying effect. The quantity of sewage entering a stream being known, it becomes possible to tell with a good degree of certainty at what distance mingled with such a volume of water, it will become so diluted, diffused and changed as to be unrecognisable by any chemical test. The dose of poisonous matter, if of a chemical nature, ought to be divided and sub-divided to such an extent as to be entirely harmless in the quantity of water that any individual would consume. In practice, however, this is not found to be the fact, sewage infection being capable of producing epidemic disease for many miles along a stream entirely out of proportion to any possible chemical process of diffusion.

The whole tendency of modern research has been to show that the question as to the spread of disease through the agency of water is biological rather than chemical. It is the presence of certain living organisms and of the conditions on which their continued existence depends that leads to the spread of disease. A single seed may be the means of overspreading an entire continent with some form of luxuriant growth, and so a single disease germ may start an epidemic, not through any mechanical or chemical process of division or subdivision, but because having life it grows and multiplies.

The danger consists not in the quantity of such organisms but in their power of growth under given conditions. If capable of living in water, they may infect an entire stream instead of disappearing by processes of dilution within a few rods. Unlike chemical poisons, they have no fixed poisonous dose. The smallest possible inoculation may prove fatal through the power of self-propagation which they possess. If, on the other hand, their growth be hindered by unfavorable temperature, moisture or food supply, they may become harmless no matter what their quantity. It is true that they have chemical effects, originating substances known as toxines, some of which are deadly poisons, but they themselves depend upon possession of life for the modes of activity which they exhibit. Throughout it is a question of vitality under particular surroundings.

Typhoid fever, cholera and certain forms of dysentery are the chief diseases whose infection it is generally admitted can live in water. In addition, about ten years ago, the writer came to the conclusion that the term malaria, signifying bad air, is a misnomer, and that diseases of this class are very largely, if not exclusively, conveyed in water. Towns taking their public water-supply from ponds or streams having distinctly malarial surroundings have become subject to such fevers although previously free from them.

The manner of spreading of the diseases which have been named originates two classes of dangers. If water be taken from the vicinity of human habitations there is liability to contamination from excreta washed into the pond or stream used as a source of supply, or, in the case of wells, the strong action of powerful pumps may originate a rapid flow underground extending many hundreds of feet and carrying impurities through coarse gravel or open crevices in the soil. That this is the fact appears from the manner in which ordinary wells at a considera-

ble distance from the pumping station run dry when the latter is in operation. Such contamination from human sources may originate typhoid and diarrheal disorders. If, on the other hand, the source of supply is remote from human habitation there may be malarial contamination. Indeed the natural habitat of malaria is in new and undrained countries and virgin soil. In view of this distribution of the disease it is surprising that well-drained cities, having perfect sewers, should yield a certain percentage of malarial fevers until the source of their water-supply is noted, it being in such cases, as a rule, some pond or stream in whose vicinity these diseases are prevalent. Shallow wells in alluvial soil also may yield malarial infection. It is said that since the substitution of deeper artesian borings for such wells there has been a notable decrease of malarial diseases in some parts of the Southern States of North America.

In many localities it is difficult, if not impossible, to secure an adequate supply of water free from the forms of contamination to which reference has been made. This necessitates some system of purification.

It has been discovered recently that there is an antagonism between disease germs and what are known as nitrifying organisms, which produce nitrates and nitrites in the soil. Advantage has been taken of this to institute an intermittent process of filtration. Water containing the bacteria that it is desired to destroy is allowed to run into a filter composed of sand, containing an abundance of nitrifying organisms, and instead of being drawn off immediately is allowed to stand for a sufficient length of time to permit the destruction of the disease germs by their natural foes.

Such filtration as that just described is but the perfecting of natural processes. Alternation of rainfall and dry weather operates substantially on the same plan, tending to purify the ground water in the soil from infec-

tion and making wells possible. Thus in localities where artificial filter beds are impracticable it may be possible to resort to wells with similar results. Experimental borings are required in order to determine whether the quantity of water is adequate and whether the soil through which it percolates is adapted to secure its purification. This being done and the system established, the intermittent action of the pumps, running a part of each day like intermittent filtration, yields a much purer supply than could be had in any other way. A point to be guarded against is the influx of surface water, which is specially liable to contain malarial infection as well as other impurities. To this end, numerous small wells, consisting of iron pipes put down to the proper depth and having perforations over a space of six or eight feet from their lower extremities, covered with fine wire gauze, may be employed. Another plan that may serve is to have a single large well, twenty feet or more in diameter. A convenient method of construction of such a well is by the use of a curb, built up in a hexagonal or octagonal form, of plank laid flatwise and spiked one upon the other in layers. If such a curb be made, slightly smaller towards the top, it can be carried down successfully through almost any sort of soil and stoned up.

It has been thought best to enter somewhat into such details as have been indicated, because they illustrate the principles involved in improvement of water supply, especial reference having been had throughout to localities whose resources are limited. The adaptation of laboratory results to practical uses is the point specially sought to be accomplished in this brief summary. The sanitary engineer, the practising physician and the skilled microscopist are upon common ground in these studies.

At the present stage of progress it must be admitted however, that serious imperfections are unavoidable in the

best systems of water-supply available in many localities. This being the case, household methods of purification require to be taken into the account. That preferred by the writer is as follows: The water is boiled and allowed to stand in a covered stone jar until all sediment has deposited. It is then transferred to ordinary air-tight glass fruit jars, a lot of which, having convenient modes of fastening, are kept for the purpose. When put in an ice chest or cool cellar such water comes out beautifully clear, sparkling and palatable. Such water has no unpleasant flavor unless kept too long, and even this might be avoided by sterilising the jars and filling them with the water while hot, which would require reheating after the sediment is removed. Practically there is no necessity for this extra trouble. Certainly all the waters treated by the writer in this way have proved to be excellent, and there can be no question as to their freedom from the infection of any of the diseases that have been named in the discussion. It may be noted also that substantially the same principle is employed when water is used for quenching thirst in the form of tea, coffee, soups and the like. It is the boiling that makes such waters safe, the various ingredients added serving to please an acquired taste for the most part. Mankind is accustomed to take many precautions of this sort without any clear ideas of the reasons. It is the province of advancing civilization to enable such precautions to be taken intelligently, and consequently more perfectly, and this is the aim of the present discussion in regard to water-supply.—Proc. A. M. S.

Exchange.—H. W. Parritt, 8 Whitehall Park, N. London, England, wishes to exchange microscopical slides, books and objects for crustaceans, echinoderms, sponges, zoophytes, shells and other marine objects, fresh or dried.

The Brain of the Embryo Soft-Shelled Turtle.

SUSANNA PHELPS GAGE, PH. B.,

ITHACA, N. Y.

In a paper read before the Microscopical Society last year, upon the "Comparative Morphology of the Brain of the Soft-shelled Turtle (*Amyda mutica*) and the English Sparrow (*Passer domesticus**)," certain questions were raised, which could only be answered by studying the development in the soft-shelled turtle, as : When and how do the characteristic features of the brain in this group of turtles arise? When and how do those features arise which distinguish them from birds?

Professor Eigenmann, who was present, kindly sent me six embryos of *Aspidinectes*, a closely allied genus of the turtle, in different stages of development. Serial sections were made of the heads and mesal views reconstructed. A brief summary of the result obtained is given below. Fuller statement, with illustration, is reserved until more material is studied.

The body of the youngest specimen was 7 mm. long; the form generalized; the face short; the diameter of the eye, one-half the length of the head. A narrow carapace was distinguishable in a specimen, with length of body 11 mm. In the oldest specimen the carapace was 16x11 mm., and had the characteristic leathery appearance and markings of the adult. The snout had also the elongated form of the adult. The feet were webbed. The diameter of the eye, though twice as great as in the youngest specimen, was only one-third the length of the head.

1. As seen from the meson, the most striking difference between the early and late forms of the brain is the general shape. Taking as reference points the

*TRANSACTIONS American Microscopical Society, Vol. XVII., 1895, pp. 185—238, 5 plates.

center of the geminum, the union of the myel with the oblongata and the tip of the olfactory lobe, in the youngest embryo, the figure formed is an isocetes triangle, in the succeeding stages changing to a flattened triangle by the elongation of the base. The cephalic limb of the triangle increases greatly, while the folding of the caudal part of the brain produces an actual shortening of the caudal limb of the triangle. In the adult *Amyda* the flattening of the triangle has proceeded to an extreme. The change of form in the brain is apparently greater between the time when the external appearance of the adult is established, as in the oldest embryo, and the true adult condition, than between the oldest and youngest of the above described embryos. This is due to the fact that after the external adult appearance is complete the cerebrum and the cerebellum both acquire their largest comparative growth.

2. At the constriction occurring in the brain-tube, between the postcommissure and the floor of the cranial flexure, the brain shows the least increase in size, as shown by different measurements upon the meson of the embryo and adult brain. This stationary condition is probably due to the early maturing of the region.

3. The union of the olfactory lobes across the meson was not found in these turtles until the beginning of the carapace was distinguishable, and did not present the comparative extent and close connection of the adult until the oldest embryo had the adult appearance. That is, as was found with the sparrow, the union across the meson is of late occurrence and secondary importance.

4. Those parts of the cerebrum, apparently connected with olfaction, the hippocampal, progress with equal step with the olfactory lobe, and not until the oldest embryo is the fimbrial edge of the hippocamp and its union across the meson, the fornicommissure, well established. The late appearance of this commissure is con-

sonant with great variation in different types, but this study tends to corroborate the opinion now gaining ground, that this commissure in the lower vertebrates is not a callosum.

5. That part of the cerebrum so prominent in the adult, the caudatum, or elevated portion of the striatum, is only found as a rather inconspicuous object in the oldest embryo, but the precommissure, in which fibers from the upper parts of the striatum cross, arises as the carapace begins to form.

6. In the roof of the brain the postcommissure is a well-formed landmark in the earliest of the embryos, while the commissure, bounding the opening of the epiphysis, the supracommissure, shows as a mere trace in the youngest embryo and attains a disproportionate development in the oldest. A similar culmination in growth is seen in the oldest embryo in the associated epiphysis, habenae and the fiber tract extending from this region to the cerebrum, a fact apparently indicating that in ancestors of this group having comparatively simple brains these parts were of more importance, for in the adult turtle they are overshadowed by the later developing parts.

7. The membranous roof in all embryos is a simple unfolded membrane, clearly continuous with the paraplexuses of the cerebrum. The latter, in the early stages, are simple membranes, which show folds only when the carapace begins to develop, and become quite complex in the oldest embryo. The paraphysis, at the point of union of the diaplexus with the paraplexuses, is a widely open tube in all the stages, and becomes early convoluted.

8. The medicommissure, a feature which is found in mammals and reptiles, but not in birds, arises in this turtle only in the oldest embryo, in this being like mammals, in which it also appears late, and showing that

though characteristic, it is of secondary importance.

9. In the infundibular region of the embryo are seen distinct folds and pits, which are nearly obliterated in the adult. A pair of protuberances, dorsad of the hypophysis, occurs in the younger forms, and is represented in the adult by a single mesal notch. Dorsad of the hypophysis, occurs in the younger forms, and is represented in the adult by a single mesal notch. Dorsad of these a mesal protuberance, lying between two commissures, is much more prominent in the younger specimens before the commissures are formed. The decision upon homologies of these protrusions of the wall with either the albicans of the higher forms or the hypoaria of fishes must be reserved, there are details of difference in both.

10. In the turtle, all parts connected with vision are well developed. In the youngest embryo the optic recess is clearly traceable to the eye along the optic nerve, as the remains of the originally open vesicle. This remnant becomes more convoluted, the endymal cells giving an almost glandular appearance, in the stages when the carapace begins to develop. In the oldest embryo this appearance is gone, but the numerous cells of the chiasma in the adult may represent this convoluted vesicular remnant.

11. The optic geminum does not lose the form of a thin roofed single vesicle until in the oldest embryo a mesal depression occurs, forming the paired geminums, and at the same time an extensive union across the meson by means of the geminal commissure, and a division of the cells into two layers arise. The late formation of this solid roof of the geminums is interesting in connection with the fact that in birds the roof is a membrane.

12. In the latest embryo the cerebellum is only just beginning its growth as a great mesal feature, though considerably earlier it is apparent as a lateral organ. In the youngest embryo its appearance is like that of

the *Amphibia*, having a small mesal portion. With its growth caudad it revolves, so to speak, about a fixed point, carrying the thin membranous wall before it, and thus forms the folded metaplexus of the adult. The oldest embryo shows this admirably.

13. The floor of the oblongata undergoes wonderful changes, from a comparatively thin-walled condition in the youngest embryo, through one in which series of rounded thickenings occur, these in turn becoming united, as the carapace develops, to form the continuous thickened floor of the oldest embryo.

From the above it is seen that partial answers to the questions mentioned are now possible.

(a.) The general form of the brain of the soft-shelled turtle wherein it differs markedly from the other described turtles is only acquired after the embryo has the external appearance of the adult, the great relative growth of the cerebrum and cerebellum taking place after that period. (Sec. 1, 2.)

(b.) The union of the olfactory lobes across the meson and the large caudal growth of the cerebellum seem to be characteristic of this group of turtles, and it was found that both are of late development. (Sec. 3, 12.)

(c.) The broad distinctions between the bird and reptile brain are, that the latter possesses a medicommissure and a solid roof to the geminums; in the soft-shelled turtle both of these features arise in the late embryo.

That is, in the brain not only those features which distinguish the group of turtles, but which most evidently distinguish birds from reptiles, arise in this turtle about the time the external form is characteristic of the genera. The brain, however, lags somewhat behind the body in assuming characteristic features.

Other questions arose as to the appearance of the nidi and their relation to sulci, which cannot yet be answered conclusively.

On the Seeds and Testa of Some Cruciferae.

By L. H. PAMMEL.

AMES, IOWA.

WITH FRONTISPIECE.

Continued from page 274,

CAMELINA SATIVA, CRANTZ.

Pod obovoid, four to six lines long, smooth, reticulated, margined from beak down along placental side with smaller ribs between them. Seeds light brown, one line long, minutely pitted, caulicle prominent, running lengthwise with a prominent groove between it and the cotyledons. Cotyledons incumbent.*

Seed coats consisting of four layers. The outer epidermal cells not much longer than wide, on the addition of water become mucilaginous and well stratified. On the addition of chloral hydrate stratification more evident. The cell-walls differentiated into several different substances. The second layer not always developed. Cells of third layer with thick walls and brown pigment, followed by a narrow layer of thick walled brown cells. The first row of cells of endosperm, rather thick walled, filled with protein grains, the other layers of unequal development, cells elongated, thickwalled; followed by cells of embryo; these contain protein grains and fat.

EXPLANATION OF THE FIGURES.

I. July text, page 209, (Reprint, page 7). *Brassica nigra*: a, mucilaginous cell before the addition of water; b, after addition of water; 3, brown thick-walled cells; 4, parenchyma cells; 5, aleurone layer; 5-6, endosperm; 7, cells of embryo. *B. sinapistrum*: c, mucilage cells expanded; 4, endosperm in figure to the left, embryo in figure to the right.

II. September frontispiece (Reprint, page 12). *Sisymbrium altissimum*, *S. officinale* and *Capsella bursa-pastoris*: The upper row of cells consists of mucilage cells; the lower row contains embryos; about midway between may be seen the endosperm.

III. September text (Reprint, page 13). *Lepidium virginicum*. 1, mucilage cells; 3, 4, endosperm; 5, cells of embryo; b, mucilage cells when moistened.

IV. October frontispiece (Reprint, page 15). *Brassica alba*: Upper row, mucilage cells; third and fourth rows, endosperm. *Camelina sativa*: upper

*Harz. l. c. p. 924. Fig. 71.

row, mucilage cells; third row, thick-walled cells; fourth row, aleurone cells; lower row, cells of embryo. Figures on right of plate, mucilage cells when moistened.

All the figures were drawn to the same scale.—X320.

A Partial Bibliography on Mustard Seeds.

The writer wishes to express his obligations to Prof. Wm. Trelease of the Missouri Botanical Garden, who allowed free access to the library of the garden for the purpose of completing this list.

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A Cause of Foul Water in Reservoirs.

BY ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

To the presence of a bacillarian, a diatom in fact, is due a certain fouling of drinking water. Prof. Leeds, of the Stevens Institute of Technology has given to it the name of *Asterionella flavor*. In the report on the city water of Brooklyn, N. Y. it is detailed. The results arrived at are microscopically and technically of great value.

By order of the board constituting the department of the city works, on September 4, 1896, the Engineer was requested "to make such examination of the Brooklyn water supply as he should deem necessary, in order to determine the cause of the complaints made in regard to its quality, and the remedy to be applied.

Daily examinations showed that immediate action was necessary. The objectionable appearance, taste and odor during the mid-summer periods has been essentially due to the protista, a plant growth known as *Asterionella*.

It has nothing whatsoever to do with artificial causes like drainage, sewage or contamination. It is due to purely natural causes, the first being the microscopical chemical constituents of the water, and the second, and even more important, being the physical conditions in which the water is placed after entering the reservoirs. The important questions to consider are:

I. What is the *Asterionella*, and what is peculiar about it?

II. What is there in the composition of the Brooklyn water, or the mode of handling and storing it, that has fitted it especially for the development of the *Asterionella*?

III. How can growth of this organism be prevented?

I. *Asterionella* derives its name from its form, being a star-shaped organism usually 3- or 4-rayed. It is a diatom, a bacillarian, usually called an alga, although more properly called a protiston. The latter is distinguished from most other algæ by being enclosed or having a skeleton or envelope capsule of silica, or soluble silica hydrate. This particular genus has the further peculiarity of secreting a substance in the nature of an oil which possesses a taste and odor so characteristic that, for lack of a better name, is called *Asterionella* flavor. It is a combination of fishy, salty and oily tastes, its odor resembling that of certain varieties of geranium.

Although some of the samples of the reservoir water contained as many as twenty million individuals to the gallon, yet it would require many hundred gallons of the water to get enough of the oily product which imparts taste and odor, to work upon in the laboratory to accurately determine its nature. In many of its properties it resembles trimethylamine.

In the month of August, when the trouble was at its worst, the water had a white appearance and was filled

with minute white threads. On standing, it threw down a flocculent deposit of a stringy, whitish or yellowish white matter. Under the microscope, this deposit was found to consist of innumerable *Asterionella* matted together with other diatoms strung together in threads the other diatoms, being more especially *Melosira*, *Tabel-laria* and *Synedra*. These thread-like forms have not been noticed to produce the objectionable taste and odor secreted by the *Asterionella*, and, moreover, they were vastly less abundant. The water itself was colorless, the apparent color being due to the suspended organisms. The oily taste-producing substance is volatile and cannot be gotten rid of by distillation. It distills over with the steam, giving to the distilled water a faint whitish appearance or opalescence, and communicates to it the same characteristic taste and smell.

Neither can it be got rid of by filtration through paper or cotton or a thin layer of sand. Sand will arrest nearly all the *Asterionella* and then on being washed with pure water, the water used in washing and containing the plant will be found to have taken up the taste and odor. To remove both the *Asterionella* and all the taste and odor arising from it, it is necessary to filter through animal charcoal or through a properly constructed sand filter of sufficient depth.

The most characteristic feature of the diatom is its envelope of silica. There are many other kinds of microscopic organisms represented in the different portions of the Brooklyn water supply, such as green algæ, the bluish green algæ and the fungi, Rhizopods, Rotifers, Crustaceans, etc., but none of these are characterized by the presence of silica, and do not in the same sense imperatively demand it as a constituent of their food. Moreover, the number of non-silex-secreting organisms is insignificant when compared with the stupendous number of diatoms. Thus Prof. Leeds says, but he for-

gets that the silica in the loricae of bacillaria, or diatoms, is in a very soluble form and bacillaria are also present in all water, marine, brackish and fresh, the world over. Silica can also be dissolved when in the crystalline form, as clear, transparent rock crystal. It is very likely that in this manner silica comes into solution and not by the action of alkali, potash or soda, which are also common in all soils. But, he says, "such being the case there must be a great abundance of dissolved silica in the Brooklyn water, and something in the nature of the water-shed which enables it to impart the silica. As a matter of fact, the ponds and streams contributing to the Brooklyn supply have sides and bottoms of sand, which is silica in an undissolved form." But silica is always soluble! "Moreover all the water has an alkaline reaction and is capable, therefore, of dissolving silica and holding it in a soluble form. The wells, indeed, are the chief source of the silex of the Brooklyn water. The complete analysis of the mineral constituents given later shows the wells to contain 1.5 parts per 100,000 of silica. But by dilution with the surface waters containing relatively less, the silica in the combined supply is only about half as much. But even then, it amounts to 9 per cent of the total mineral matter present. This large amount is more than ample for the nutriment of the enormous number of silicious algæ which thrive and multiply in the Brooklyn resevoirs and distributing mains.

Where do these Bacillaria come from? A microscopical examination of the water from several Brooklyn shallow wells, shows a few Bacillaria, the Asterionella, however, being found but once. From one basin however they were plentiful, being 6,400 per cubic centimetre. The sample taken from the centre, but at the bottom of the resevoir, at the same time, contained 11,616 and the efflux 9,552 Asterionella.

Besides the silica, what else in the way of food do the

Bacillaria require? Multiplied observations in many localities have shown that such a stupendous growth as the reservoirs exhibited last summer is possible only when there is present an abundant supply of food in the form of assimilable nitrogen.

Why should this transformation of ammonia, nitrites and nitrates into nitrogen and the immense multiplication of *Asterionella* take place in the reservoir, and not in some pond or stream where *Asterionella* are found, and where abundance of food is likewise present? To explain this it is necessary to have recourse to what is known of the habits of life of the *Asterionella* in cases where its enormous multiplication, along with the accompanying taste and odor have been observed. Its multiplication is essentially favored by abundant access of light; by a gentle, tremulous motion in the water, and by storage in shallow reservoirs. All of these conditions exist in an convenient degree in the Brooklyn reservoirs. Together with the kind and quantity of food they are ample to explain what occurred in an aggravated form last summer, what is observable now, although to a far lesser extent, and what will occur at different seasons in the future until the physical conditions that render the occurrence possible have been removed.

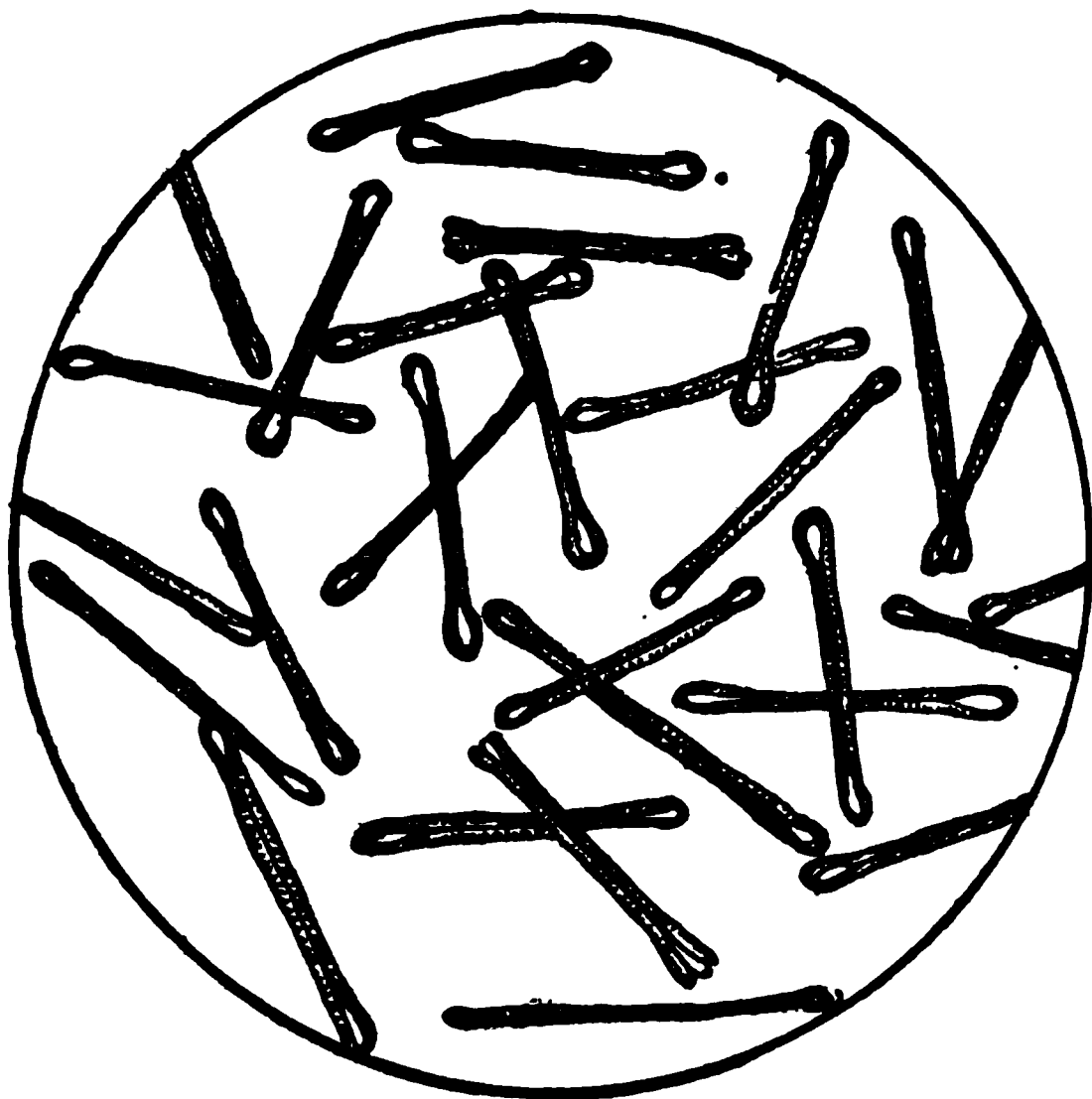
So far as is known the only remedy which has proved effectual has been that of excluding the light, and converting the reservoir into a substantially subterranean basin. The proposal to aerate the water, which was advocated last summer, was fortunately, not entertained. Prof. Leeds speaks with the more positiveness upon the subject inasmuch as he introduced the mechanical aeration of water supplies, and has seen its introduction followed by the happiest results in cases where conditions favorable to stagnation were dominant. But the reverse of such conditions exists in the present instance, and the aeration of the water in the Brooklyn reservoirs

with its accompanying large expense, would result only in intensifying the trouble. Neither will filtration of the waters before they enter the reservoirs answer. In fact he thinks that the *Asterionella* is the chief cause of the trouble. I have taken the above facts from Prof. Leed's report and commend it to the attention of every one interested in pure drinking water.

Prof. Leeds says that the *Asterionella* flavor is from a substance which in many of its properties resembles trimethylamine, and trimethylamine occurs somewhat widely distributed in nature. Thus, for instance, it is found in various plants, as the *Chenopodium vulvaria*, *Annica montana*, *Murcurialis annua*, the bloom of the hawthorn, that of the wild cherry, and of the pear, as well as in ergot, and other fungi parasitic on cereals. It also occurs in various animal liquids, and especially in herring-brine. It is likewise found as a product of decomposition of various alkaloids, and amongst the products of dry distillation of nitrogenous, organic matter and of wood. It has a powerful and penetrating characteristic fish-like smell. I have found it as a characteristic twice of *Asterionella* in the season when ovulation takes place and it seems to be characteristic of the enlargement of the oil globules as they are called, or ova as I designate them.

The reproduction of the *Bacillaria* seems to be this: As the individual is found, it contains, besides endochrome, or olive-colored matter, large oil globules which are transparent and look extremely like drops of oil. These are colorless and permanent so that when the *Bacillarian* individual is dried up the endochrome withers away but the oil globule stays and when the individual is acted upon by acid, the oil globule is not so readily acted upon. These I shall show are ova or female organs, as the individual opens there appear certain minute dots which are extremely active in motion. They increase in

quantity and at one stage occupy a large part of the interior of the frustule, the endochrome withering away or being crowded to the sides. As the breeding season approaches the interior is often dotted by innumerable active little globules and two or sometimes more ova or oil globules. Then in some way the contact of the anthozoa, as I have called these active little globules, and the ova takes place. How, I know not for they are ex-



Asterionella flavor.

tremely minute and the contact is only momentary. But sometime, I think that I shall see how the contact takes place. At this time, or evolution, the characteristic odor, the formation of trimethylamine smelling, takes place. This is the ovulation of Bacillaria. It takes place in all forms more or less, but is most rapid in forms which occur in such enormous quantities. This form I have found to be as rapid as any in coming and going. Perhaps it is more so than other Bacillarian.

The Microbe of Yellow Fever.

BY GIUSEPPE SANARELLI, M. D.

MONTEVIDEO, URUGUAY.

The best way to demonstrate not only the presence, but also its special tendency to arrange itself in small groups, preferably in the blood capillaries, consists in placing in the incubator, at 37° C. for twelve hours, a fragment of the liver taken from a fresh cadaver in order to favor the multiplication of the specific microbe. The yellow-fever bacillus grows sufficiently well in all the ordinary culture media. In common gelatin it forms rounded colonies, transparent and granular, which during the first three or four days present an aspect analogous to that of leucocytes.

The granulation of the colony becomes more and more pronounced, appearing ordinarily as a nucleus, central or peripheral, completely opaque; in time the whole colony grows entirely opaque. It never liquefies gelatin.

In beef bouillon the bacillus grows quickly, without forming either pellicles or deposits.

On blood serum solidified it grows in a manner almost imperceptible.

Cultures on agar-agar represent for the "bacillus icteroides" a means of diagnosis of the first order; but the demonstration by this means of diagnosis is efficacious only under certain determined conditions.

When the colonies grow in the incubator, they present an appearance that does not differ from that of the majority of the other species of microbes; they are rounded, of a slightly iridescent gray color, transparent, even in surface, and regular in outline.

If, instead of causing the colonies to grow in the incubator at a temperature of 37° C., they are allowed to evolve at a temperature of from 20°-22° C., they appear like drops of milk, opaque, projecting, and with pearly

reflections; that is to say, they are completely distinct from those grown in the incubator.

These different modes of evolution can be used for diagnosis by exposing cultures, first, for from twelve to sixteen hours to the temperature of the incubator, and afterward for other twelve to sixteen hours to the temperature of the air.

This done, the colonies show themselves to be constructed with a flat central nucleus, transparent and azure, having a peripheral circle prominent and opaque. This peculiarity, which may be considered specific, may be made evident in less than twenty-four hours, serving thus to establish the bacteriological diagnosis of the "bacillus icteroides."

Apart from this morphological characteristic, which suffices of itself to differentiate the microbe of yellow fever from all others previously known, the "bacillus icteroides" is endowed with some interesting biological qualities.

It is a facultative anaerobe, and does not resist the Gram stain; it ferments insensibly lactose, more actively glucose and saccharose, but is unable to coagulate milk; it does not produce indol, and is very resistant to drying; it dies in water at 60° C. or after being exposed for seven hours to the solar rays, and lives for a long time in sea water.

The microbe of yellow fever is pathogenic for the greater number of the domestic animals. Few microbes have a pathological dominion so extended and so varied. Birds are completely refractory, but all the mammiferous animals upon which I have experimented have shown themselves more or less susceptible.

But of all the animals, that which lends itself best to showing the close analogy, anatomically and nosologically, between experimental yellow fever and human yellow fever, is the dog.

The virus should be injected into a vein. The morbid process that results manifests itself almost immediately, with a violence of symptoms and an assemblage of lesions which recall the picture, clinical and anatomical, of human yellow fever.

The lesions found after death are extremely interesting, as they are almost identical with those observed in the human cadaver.

Attention is called before everything to the intense fatty degeneration of the liver. The hepatic cell, examined in a fresh state with a little osmic acid, appears completely turned into fat, as it is in human victims of yellow fever; the yellow-fever toxin, as we shall see later is a true specific poison to the hepatic cell, as are phosphorus and arsenic. A complete fatty degeneration of the liver may be affected by injecting directly into it, through the abdominal parietes, a fresh culture of the specific bacillus.

The kidney shows a severe fatty degeneration, accompanied by lesions of acute parenchymatous nephritis, which may be considered the direct causes of the anuria and the uræmic intoxication.

The digestive apparatus shows lesions of hemorrhagic gastro-enteritis as intense as those caused by poisoning with cyanide of potassium. They are completely analogous to those in man, though more grave.

A bacteriological fact of great interest in the yellow fever of the dog is that in the majority of cases the "bacillus icteroides" is found in the blood and the organs in variable quantity and in a state of absolute purity; at times, it is found associated, as in man, with the coli bacillus and the streptococcus.

As the tendency to secondary microbic infections has been proved even in the yellow fever intoxication of the dog, provoked with a pure culture, filtered, it must be concluded that the yellow fever poison, whether by itself

or whether through the alterations it produces in the different viscera, and especially in the liver—which, as is well known, should be considered the organ of defense against microbes—favors in the dog secondary infections having their point of departure in the intestinal canal.

This is an important point of resemblance between the yellow fever of the dog and that of man.

From the results of the first part of the investigations relative solely to the comparative morphology, biology, and pathology of the “bacillus icteroides,” we can deduce some fundamental conclusions concerning the etiology and the pathology of the yellow fever of man.

Yellow fever is, then, an infectious disease, due to an organism well defined and susceptible of being cultivated in the common artificial nutritive media.

The micro-organism, which I have designated provisionally with the name of “bacillus icteroides,” can be isolated, not only from the cadaver, but also during the life of the yellow fever patient.

Its isolation presents generally difficulties, sometimes invincible, due in part to the constant presence of secondary infections, and in part to the relative scarcity of the organism in the body.

These secondary infections, due almost always to certain species of microbes, as the coli bacillus, the streptococcus, the staphylococcus, the proteus, etc., may appear in the organism long before the death of the patient, which is often attributable to their action rather than to that of the “bacillus icteroides.”—*Med. Record.*

DO YOU WANT GOLD? Everyone wants to keep posted on Yukon, the Klondyke and Alaskan gold fields. Send 10 cents for large Compendium of vast Information and large color map to Hamilton Pub. Co., Indianapolis, Indiana.

EDITORIAL.

Benjamin F. Quinby, of Chicago, died suddenly at Goshen, Ind., July 18, 1897, aged 62 years. He was born in Concord, N. H. and moved to Chicago in 1853, having previously been in a wholesale grocery in Philadelphia. For twenty years past he has been in employ of Fuller, Fuller & Co.

He was active in scientific matters and was one of the oldest members and at one time president of the Illinois State Microscopical society. He was also a member of the Academy of Science of Philadelphia, and that of Chicago, and of the Royal Microscopical society of London. He was well known as an entomologist and his microscopical preparations on insects were known in many other places than Chicago.

Life in Diamonds.—Professor von Schoen, of the faculty of Naples University, and Professor Edward Von Holst of the Chicago University, propose to obliterate the line of demarkation between the organic world and diamonds. They have made photomicrographs, which views, says the Mineral Collector, show the crystal in its birth, the head showing forth from the mother crystal, and the course is followed as it pushes out and away. The crystal meets another one from a different mother. The two strike at each other, they fight, strive and clasp with each other. It is a case of the survival of the fittest. One must die. No two crystals from the same mother ever fight, however, no matter where they meet.

MICROSCOPICAL APPARATUS.

Photo-Micrography.—The following is perhaps the most simple method of doing what is required. Take a smoothly-planed board about 3ft. by 6in. by $\frac{3}{4}$ in., and straight down the center thereof cut a slot about 2ft. long by $\frac{1}{2}$ in. wide, and lastly, affix on the under side, at each extreme end, a fillet about $1\frac{1}{2}$ in. wide by $\frac{3}{4}$ in. thick to strengthen the board and raise it slightly from the sur-

face on which it is to stand, level and firm. As the camera to be used only extends 9in., a box-like extension piece—adding, say, an extra 4in.—should be made and fitted to the front. The camera is secured to one end of the board by means of a usual tripod screw passed from beneath through the long slot, and the microscope is so placed, turned horizontally on its stand, that the eyepiece points centrally through the usual lens *mount* into the camera, the junction between the two being made light-tight by a small velvet sleeve having elastic bands at each end. The ordinary focusing-screen is utterly useless for micrographic work, it being necessary to use a piece of thin patent plate glass, having lines ruled on one side with a diamond. Correct focus is obtained when these lines and the image are seen in focus together through a compound focusser. The condenser and lamp (if the last is used) are, of course, arranged at the other end of the board opposite the microscope and camera.

MICROSCOPICAL MANIPULATION.

Staining Insects' Wings.—Dr. Brodie has given much attention to the setting up and preservation of insects. The following mode of staining the wings of insects which he has devised, will be both useful and interesting. Place the whole insect in a strong alcoholic solution of fuchsin, and allow it to remain there for forty-eight hours. Then transfer the insect to water with a pair of fine forceps, and wash it until no more color comes away, changing the water if necessary. While the washed insect floats in clear water, slip a microscope slide, holding the insect on it with a fine needle, separate the wings from the body with a fine scalpel, and remove the body. Float the wings into position on a drop of clear water, remove excess of water with blotting-paper and allow to dry. Then place a drop of thick Canada-balsam near them and heat over a spirit-lamp. Tilt the slide to allow the liquefied balsam to flow over the wings, lower a cover-glass gently into position and allow to cool. On examination the veins will be found red, the

depth of coloring varying with the length of time of staining, the thickness of the veins, etc.—Science-Gossip.

BACTERIOLOGY.

Anthrax Bacteria in Hides from China.—During the early part of August four deaths occurred among the employes of the Falls Creek tannery near Dubois, Pa., and several cases of severe illness have been reported. Some time ago the tannery company received an invoice of 100,000 hides imported from China. During the process of tanning the liquors drained into the creek. Not long afterwards several head of cattle running at large died. It was discovered that the cattle drank water from the creek. Shortly afterwards several employes were taken sick and in some cases death resulted.

Investigation revealed the fact that the hides were infected with anthrax bacteria. Considerable alarm was caused at Falls Creek over the fatal effects and possible spread of the disease as it proves fatal in from five to eight days, and of the men affected only one has so far recovered.

The matter has been kept as secret as possible, but it is understood that the matter has been reported to the State board of health and an investigation will be instituted.

Pathogenic Organisms and Living Plant Tissues.—Several years ago Dr. H. L. Russel published an interesting paper on "Bacteria in their Relation to Vegetable Tissue" in which it was demonstrated that some of the forms adapted to a saprophytic mode of life may live for considerable periods of time in living plants, but few of the facultative parasites were able to thus live. *Bacillus pyocyaneus* oval schweine senche bacillus did so for some time. These micro-organisms were usually found intracellular. Dr. Karl Kornanter, who has recently investigated this question, makes no reference to this excellent paper. Kornanter worked with pathogenic and saprophytic species. In the case of anthrax bacillus and *Streptococcus pyogenes* the germs did not penetrate the tissues of corn or pea, in

germination the young plants having passed through cultures containing these organisms. Nor were his results with other pathogenic saprophytic organisms more favorable where onions or hyacinth bulbs were used, or when cultures were inoculated into plants above ground. Various minerals speedily destroyed the organisms. It is not probable therefore that pathogenic bacteria are ever taken up by the roots of plants.

Appropriation of Free Atmospheric Nitrogen.—Nitrogradsky is well-known on account of his extended and thorough studies of micro-organisms in connection with the subject of nitrification. He has now given us the result of his studies on the above topic. In isolating these organisms he used what is by him termed the "elective" method of isolation. In this special case a culture medium was employed that was free from all combined nitrogen. It was made up as follows:

Distilled water, 1000cc; 20–40 gr. dextrose; 1 gr. potassium phosphate; 0.5 gr. magnesium sulphate; 0.01–0.02 gr. potassium chlorate, sulphate of iron, sulphate of manganese. This culture medium was then inoculated with garden earth. Most of the cultures soon showed evidence of butyric acid fermentation. Gas bubbles appearing in the immediate vicinity small masses floating in the medium. These masses somewhat resembled Kephir grains. This fermentation continued till all of the sugar was used up. After this fermentation, mould developed on these white grain-like masses, followed by algae. It appears that this medium at first wholly unsuited for higher plants because of the absence of nitrogen was made suitable when appropriation of nitrogen by bacteria had taken place. The Kephir like masses consisted of a species of *Clostridium* to which he has given the name of *C. pasteurianum*, and two kinds of bacteria forming threads. The interesting details cannot be given here. Suffice it to say that this *Clostridium* is capable of obtaining nitrogen from the atmosphere, which is found in the medium in part as soluble inorganic nitrogen, but mostly as insoluble organic

combined nitrogen. (Archives des Sciences biologiques T III. St. Petersburg, 1895, No. Bott. Centralbl. LXV, 277.)

MEDICAL MICROSCOPY.

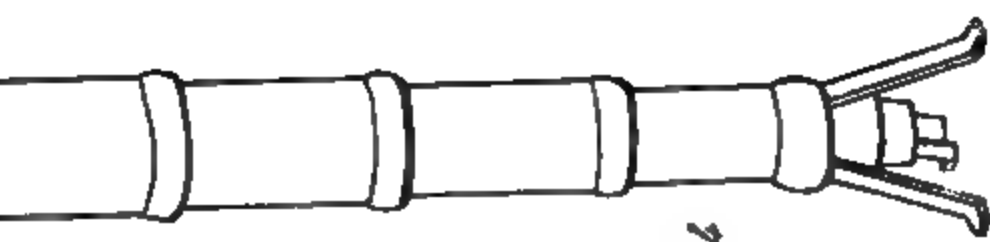
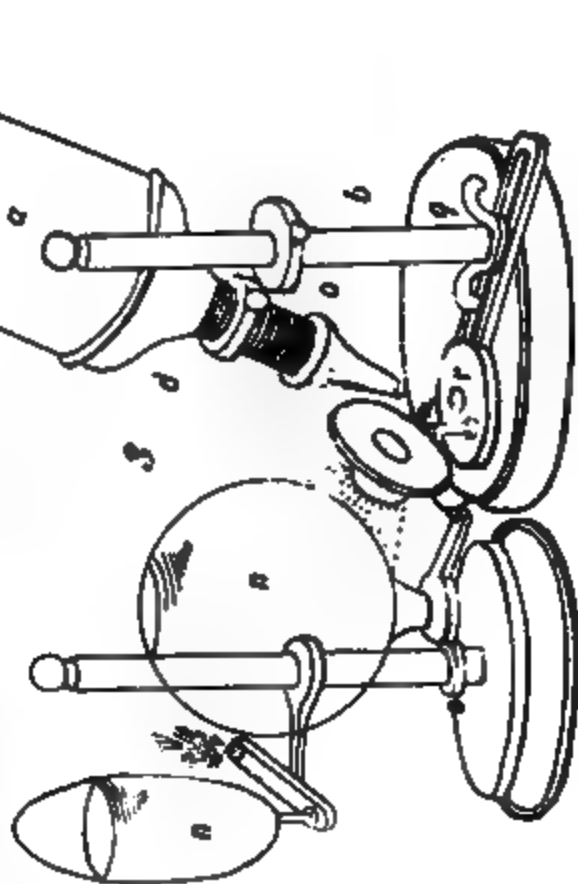
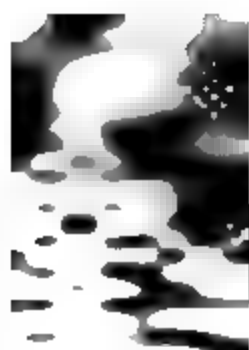
Diarrhoea in Children and Milk.—It is well-known that milk may give rise to intestinal disorders traced back to the poisonous products produced by micro-organisms. Dr. K. Alt indicates in a paper in *Deutsch. Med. Nocheuschr*, 1896, No.5, that all troubles of this kind need not necessarily be referred back to micro-organisms, but in some cases the food consumed by cattle may be responsible for some of this poisoning. In the cases referred to clover was thought to have caused the trouble. All precautions for sterilization seem not to have been taken into consideration. Dr. Alt's conclusions are not warranted.

Tsetse Fly Disease or Nagana in Zululand.—Dr. Bruce claims to have traced the connection of this disease and larger domestic animals to one of the *Flagellatis* (*Trypanosoma evansi*) which is carried over by Tsetse fly. It was shown that the fly was not poisonous, but that when the fly was allowed to take the blood of a diseased dog it could carry the disease to another animal, dog, horse, or bovine. (Centralbl. Bakt. Parasitenk. xix; Abth. I. 955.)

NEW PUBLICATIONS.

Medical Botany.—Moquin-Tandon has published an elementary treatise of 543 pages on this topic which contains numerous figures of medical plants some excellent, others rather poorly executed. The part dealing with phænogams is good but the part dealing with cryptogams is not up with the times, some rather remarkable statements being made. Just two pages are devoted to bacteria *Leptothrix fucales* and *Merismopidia* (*Sarcina ventriculi*). His information concerning these is somewhat ancient. Reference is made to this part of the work because it is a sample of what one finds too frequently in so called scientific publications.

EVOLUTION OF THE MICROSCOPE.



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On the Evolution of the Microscope.

BY EDWARD M. NELSON,

LONDON.

WITH FRONTISPIECE.

One of the means of guidance for the future is a study of the errors of the past. The end will be best served by (a) a through investigation of a good type of instrument designed at some period subsequent to the introduction of achromatism, tracing the development of its various parts from the earliest times. (b) A study of modern instruments, showing wherein and why they either follow or depart from the selected type. (c) The collation of other material bearing on the development of modern microscopes though not falling within the limits of *a* and *b*.

The first step, then, is the choice of a type. (1) It must be that towards which the modern microscope is tending. (2) It must be a permanent form.

There is only one microscope in which both these necessary conditions are to be found, and that is Powell's No. 1, for it requires the slightest observation to perceive (1) that the best modern microscopes are more and more conforming to that type, and (2) that it has remained in its present form for upwards of twenty years.

Our first duty, then, is to describe all the causes accumulated since the invention of the microscope, that have

influenced the design of Powell's No. 1. We say probably, because it is possible that Powell's No. 1, or any other form of microscope or apparatus, might have been designed by an inventor wholly unacquainted with any preceding form, though in the absence of any evidence to the contrary such a hypothesis would be highly improbable.

Those parts of this paper which treat of old microscopes are not intended to be a history of the microscopes; many interesting old forms will not even be mentioned. For the most part attention will be drawn to only those instruments that have been rungs in the ladder of evolution.

To begin, then, neither the name of the inventor nor the date of the first compound microscope has been with certainty determined. There is an extensive literature on the subject, and the conclusion arrived at is that the first microscope was probably made by Jansen, a spectacle maker, of Middelburg, in Holland, about the year 1660. An old microscope, supposed to be a Jansen, was exhibited at the loan collection of scientific instruments at South Kensington in 1876 (catalogue No. 3.510), the date of it given in the catalogue being 1590. This instrument had neither stand, object-holder, nor stage; the only mechanical movement with which it was furnished was a draw tube for separating the two convex lenses which formed the optical part of the instrument (Fig. 1).

The next step is to be found in a drawing of a simple microscope by Descartes in his "Dioptrique" in 1637. This shows a plano convex lens placed at the vertex of a concave mirror; in short it is an instrument now known as a Lieberkuhn. It is curious to note that while Descartes is very particular about the parabolic curves of his mirrors and the hyperbolic curves of his lenses the figures show the lenses turned the wrong way, which would

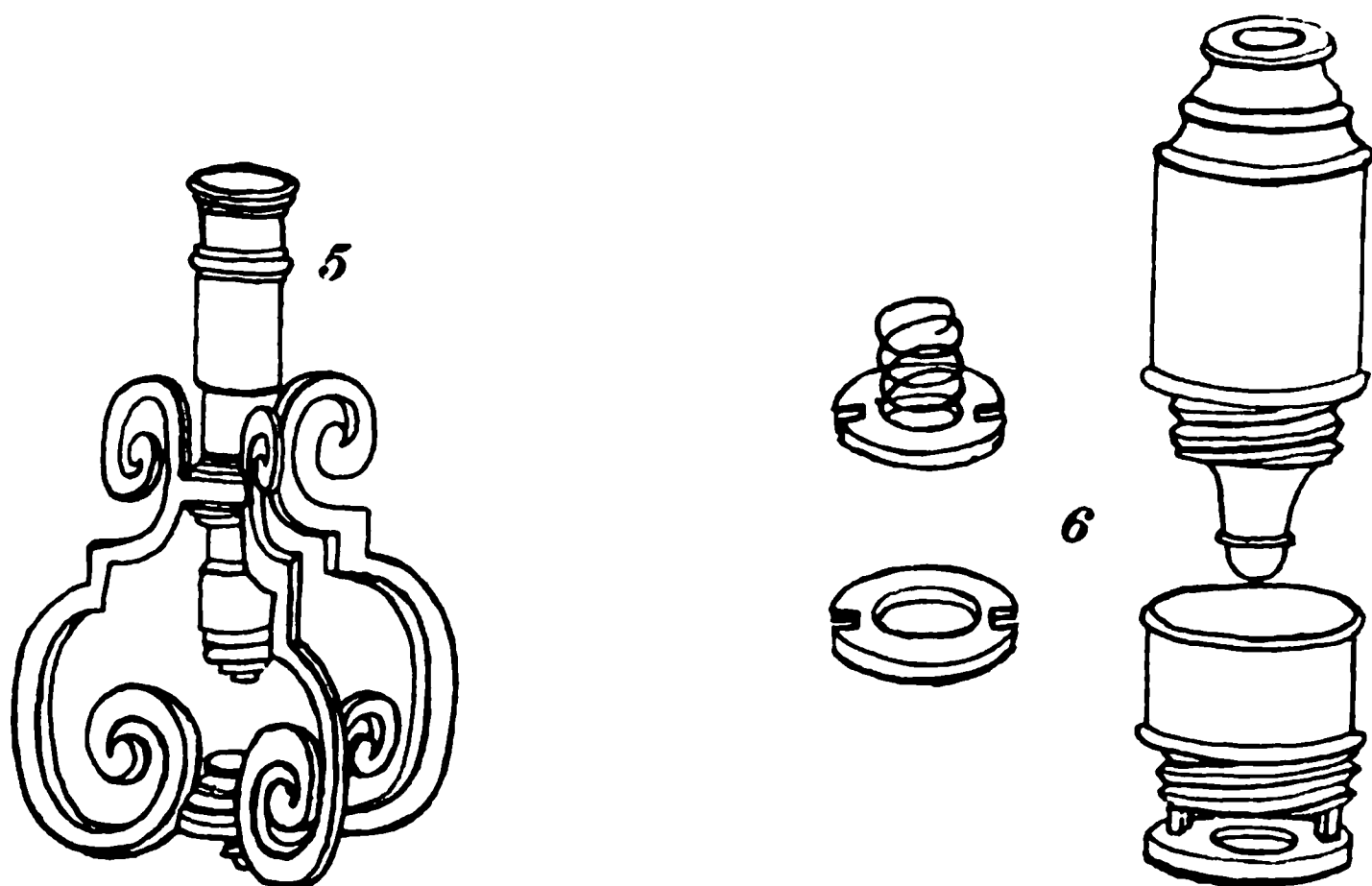
cause the spherical aberration to be increased four-fold. Now as the difference between the aberrations arising from the spherical and hyperbolic curves is for the purposes under consideration insignificant, the above is a remarkable instance of straining out a gnat and swallowing a camel (Fig. 2).

The next important step is the application of a field lens to the eye-piece by Monconys and Hooke. Monconys' microscope was made in 1660, an account of it being published in 1665. The application of a field lens was also claimed by Hooke, who in 1665 published an account of his microscope. Hooke's microscope is a very important one, for in it we find several new features, such as the inclination of the body, a screw focusing adjustment, a movable object-holder, and an entirely novel illuminating apparatus. In Fig. 3 we see a heavy circular foot, *p*, with an upright post, *b*, fixed excentrically to it. The limb which holds the body of the microscope is attached to the post by a sliding ring, *o*, and screw clamp. The limb is also jointed by a ball and socket. At the other end of the limb is a ring, *d*, into which the body screws with a coarse thread. This forms the fine adjustment. The body, *a*, was fitted with four draw tubes. This form of mounting for the body of a microscope I call the "telescope mount," for the microscope is pointed at the object precisely in the same manner as a telescope would be. There is an ingenious object-holder, *r*, consisting of a spike capable of rotation, held by a short pillar attached excentrically to a rotating disc. This disc is held in position by a link and butterfly nut, *q*; obviously, therefore, the object can be placed in any desired position by these combined movements.

The lamp also was attached to a separate upright support by a ring and screw nut, very much in the same way as it is fixed at the present time. There was an engraver's globe, *n*, filled with water for a primary con-

densing bull's eye, and a plano-convex lens, turned in its proper position, *t*, as a secondary condensing lens was fitted to a double-jointed arm. The illuminating apparatus was therefore suitable for opaque objects, and must be regarded as being very complete and efficient in its day.

Fig. 4 shows Divini's microscope (1667). The interest in this instrument is not in the mount, which is of the crudest form, but in the optical part, for in place of the biconvex eye lens two plano-convex lenses, with their



convex surfaces in contact, were used. This plan would halve the amount of the spherical aberration.

Fig. 5 exhibits an improvement on the preceding form, by Chérubin d'Orléans (1671). The body was more rigidly mounted by the enlargement of the tripod foot. A screw movement was fitted to the stage for focussing. In the optical part there is an erector. Chérubin d'Orléans was the first to apply an erector to his monocular microscope, and he was also the first to construct a binocular microscope. The binocular instrument would, according to the drawing, have given a pseudostereoscopic image.

In 1672 Sir Isaac Newton suggested a reflecting microscope of the form of a Herschelian telescope. It probably was never made.

Leeuwenhoek's microscopes, constructed in 1673, are remarkable more on account of the man who used them than for their design, which was crude in the extreme. It is indeed difficult to understand how the discoveries he made could have been carried out with such rude apparatus.

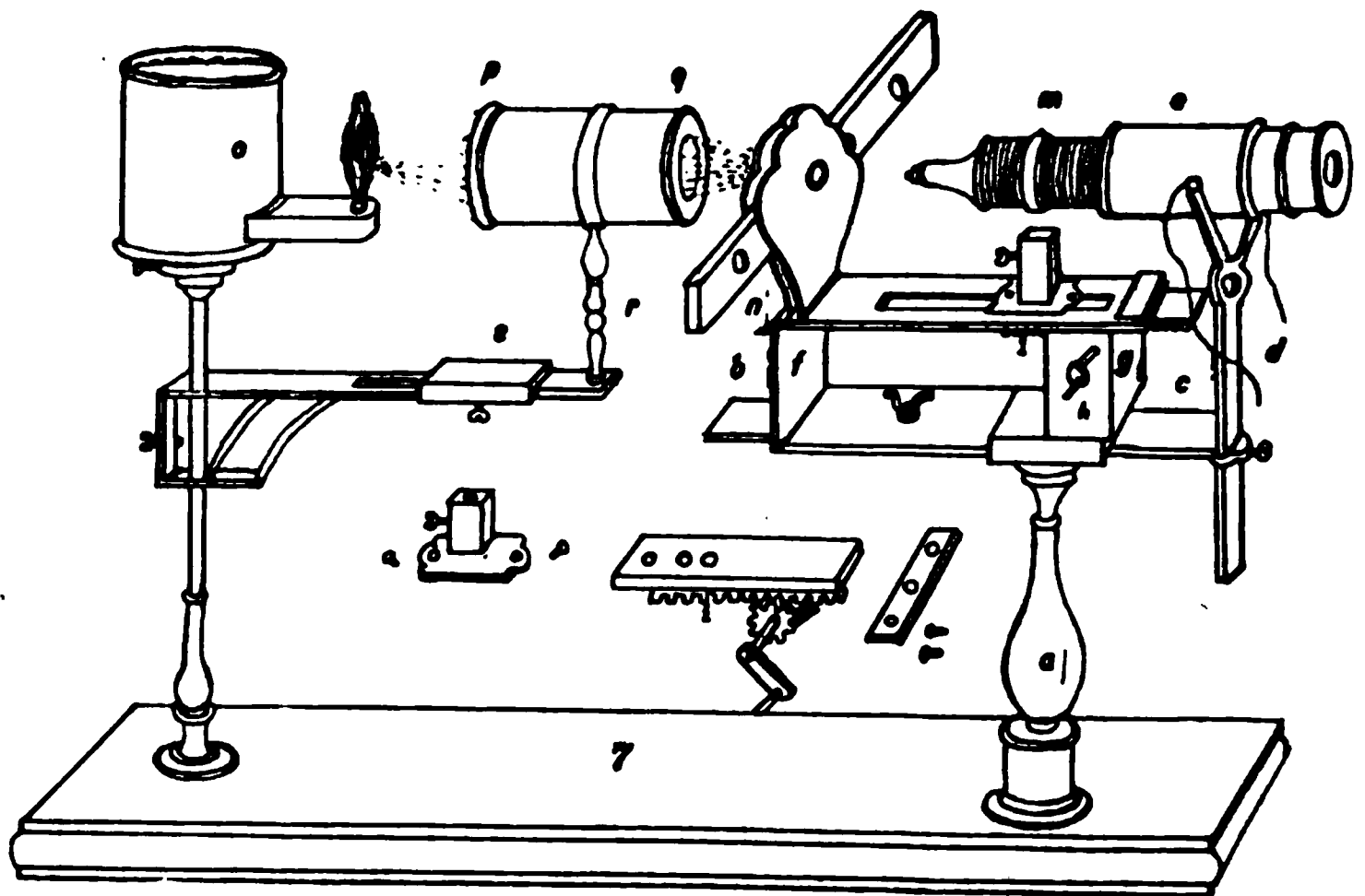
In 1687 we find a microscope by Grindl very similar to Fig. 5. The optical part, however, consisted of three pairs of plano-convex lenses.

In 1691 several new features appear. Fig. 6 shows a screw-barrel compound microscope by Bonanni. The slider placed between two plates pressed together by a spiral spring, was made to approach or recede from the objective by a screw. This simple arrangement, known as the "screw barrel," played an important part in the history of the microscope for upwards of 100 years.

To Bonanni we are also indebted for a horizontal microscope in 1691 (Fig. 7). This instrument is noteworthy, first for the double support to the body. A glance at Hooke's (Fig. 3) will convince anyone how rickety the body must have been when only held by its focussing screw, so here we have a decided improvement. Secondly, we have a rack, *i*, and pinion, *h*, coarse adjustment, in addition to the usual screw fine adjustment, *m*, of that period. There is also an improvement in the stage, and the last, and perhaps the most important novelty, is the compound substage condenser, *p*, *q*. Hooke's illuminating apparatus was, as we have seen, more suitable for opaque objects; this, on the other hand, is more adapted for the illumination of transparent objects. We now come to an excellent simple microscope by Hartsoeker, in 1694 (Fig. 8). It will be observed that the Bonanni screw-barrel focussing arrangement, *c*, *d*, is

maintained. The novelty, however, consists in the substage condensing lens, *e*, which can be focussed on the object by screwing, *f*, into the screw focussing tube. The important point in this arrangement is that the focus of the condenser is not disturbed while the object is being focussed to or from the magnifying lens. To Hartsoeker we are also indebted for a compressor.

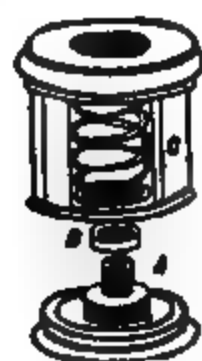
Wilson's screw-barrel, of 1702, then known as the pocket microscope, was a popular form of simple microscope in the 18th century; it was very similar to Hart-



soeker's, the main difference being that the substage condensing lens had no separate focussing adjustment. Culpeper subsequently mounted these microscopes on a pillar rising from a flat folding tripod foot, a mirror and condensing lens being attached; he also added a compound body to them. Later, in 1742, the Wilson screw barrel was mounted on a brass scroll fixed to a circular wooden foot, to which was attached a concave mirror. In this same year it is also stated that two diaphragms were supplied with the ordinary hand Wilson screw-barrel simple microscope, to fit in a cell close to the sub-

stage condenser, to reduce its aperture when high powers were used. This is the earliest notice of diaphragms for regulating the illumination.

In the year, 1702, we find a crude form of simple microscope by Mussenbroek. The only point of interest it possesses is to be found in a sector of graduated diaphragm holes. The purpose of these diaphragms was for diminishing the spherical aberration by cutting down the *apertures of the observing lens* and not for regulating the



illumination. The next model, that of John Marshall, 1704, takes us on several steps in the evolution of the microscope (Fig. 9). Here we first meet with the box-foot, a distinctive feature which lasted for nearly 130 years. The coarse adjustment is effected by a collar and jamb-screw sliding on a square bar, the fine adjustment by a direct acting screw, *f*. It is hardly correct to speak of the sliding arrangement as a coarse adjustment because the post, *a*, was marked with numbers corresponding

with similar numbers marked on the objectives; the body remained clamped at the given mark until the objective was changed, all the necessary focussing being performed by means of the direct acting screw. The great advance made in this model consists in the pivoting of the lower end of the bar, *a*, on a ball and socket joint, *b*. As the stage, *d*, is also fixed to this bar it is obvious that when the instrument is inclined the stage is also inclined with it. This feature is totally distinct from the "telescope mount," and is one specially important in the evolution of the microscope.—Queket Club.

Examination of Water.

By GEO. C. WHIPPLE,

NEWTON CENTRE, MASS.

The microscopical examination of water is becoming every year a matter of greater interest, and the study of the minute aquatic plants and animals is more and more attracting the attention of scientists. These organisms are interesting for several reasons and, besides recognizing their importance in the domain of pure science, we are beginning to appreciate the great part that they play in nature and their effect, direct and indirect, upon the human being. Their presence in surface waters is often the cause of much harm when the water is used for purposes of domestic supply; scores of instances may be mentioned where they have rendered the water entirely unfit for use. On the other hand, their presence in ponds and streams is of importance to the fish-culturist because they form the fundamental source of the food supply of fishes; this is probably true both of salt and fresh water.

Because of the connection between the number of microscopical organisms in a cubic centimeter of water and the price of fish in our markets, the study of the 'plankton,' i. e., the floating micro-organisms, is being emphasized

on both sides of the Atlantic. Observers are beginning to trace the connection between the presence of microscopical organisms and the abundance of fish in our lakes and valuable comparisons have been made between the stomach and intestinal contents of fishes and the organisms found in the water where the catches were made. This work is of very great importance and should be vigorously pursued by our fish commissions. To be of the greatest value it should extend well over the country and include lakes and ponds sufficiently different in character to enable one to determine the laws governing the nature and distribution of the plankton in various climates and under various conditions. The study ought not to be carried on spasmodically, as, for instance, during the short vacation of some college professor who generously gives his time and talents to the cause, but should be undertaken seriously and continued throughout the whole year. Only in this way can we obtain the data necessary for a complete understanding of the subject.

Since water-works managers are equally interested in the microscopical organisms found in surface waters, and up to the present time have been responsible for most of the work done upon the subject, it might be possible for fish commissions, boards of health, water-works superintendents, and others interested, to work together according to a definite concerted plan, sending their results to some central commission or committee for comparison and study. Such an extended biological study taken in connection with meteorological records and observations upon temperature, transparency, etc., of the water would be of very great value. And it would seem that we have little excuse for neglecting to cultivate this fruitful field of research. Vast numbers of microscopical examinations are now being made. During the past eight years more than 40,000 have been made in Massachusetts alone, and the rapid growth of the new science of sanitary

biology is developing numbers of well-trained observers wide awake to the value of these problems and well able to undertake the work. What is needed is cooperation.

Various methods have been employed from time to time for determining the character and amount of microscopic life in water. Those interested in the subject from the piscatorial standpoint have usually employed some sort of net for straining the organisms from the water and concentrating them for the microscope. One of the best devices of this kind is that devised by Professor Reighard and used with good results for studying the plankton in Lake Michigan. It consists of a conical net of fine bolting cloth, at the small end of which there is a 'bucket,' made by covering a metal framework with some of the same bolting cloth. The apparatus is hauled through the water, filtering a column of water whose cross section is the same as the circular mouth of the net and whose length is equal to the distance through which the net is hauled. The organisms are caught by the fine bolting cloth and are ultimately washed into the bucket. The collected material is then removed by an ingenious arrangement, measured and sent to the laboratory for microscopical examination. By this method one is enabled to get a good idea of the total amount of suspended matter in the water, but it can hardly be called an accurate method of obtaining the number of living organisms present, as the net sweeps in amorphous matter as well as organisms and some of the smaller forms undoubtedly escape through the bolting cloth. Moreover, the amount of water actually filtered cannot be told with a great degree of accuracy. Nevertheless, the method is one of value, particularly for securing the larger and rarer forms of rotifers, crustacea, etc.

Sanitarians who have studied the microscopical organisms in water supplies have usually employed very different methods from the above, partly because they have

been interested more especially in the smaller forms, but chiefly because their operations have been confined to the small quantities of water sent to the laboratories for analysis. During the last decade the old methods of sediment examination have given way to the filtration methods. The Sedgwick-Rafter method, which is most used at the present time in laboratories of water analysis, is carried on as follows:

A portion of the water to be examined is measured out in a graduate and filtered through a thin layer of quartz sand placed at the bottom of a glass funnel upon a perforated rubber stopper, the hole in which is capped with a disc of bolting cloth. When the water has filtered the organisms will be found upon the sand while the filtered water will be free from them. The rubber stopper is then removed and the sand washed into a test tube, with a measured quantity of distilled water delivered from a pipette. Usually 250 or 500 c. c. of the sample are filtered and the sand washed with 5 c. c. The test tube is then thoroughly shaken and the water decanted into a second tube; the organisms being lighter than the sand, will pass off with the water, leaving the sand clean upon the walls of the first tube. In this way the organisms are concentrated 50 or 100 times. One c. c. of this concentrated fluid is then transferred to a counting cell, which just holds it and which has a superficial area of 1,000 sq. mm. After putting a thin glass cover-slip over this cell it is transferred to the stage of the microscope for examination. The eye-piece of the microscope is fitted with a micrometer in the shape of a ruled square of such a size as to cover one square mm. on the stage, i. e. one thousandth of the entire area of the cell. The organisms observed within the limits of the ruled square are then counted and the cell moved until another portion comes into view, when another count is made. Thus 10 or 20 squares are counted and the number of organisms

present in the sample can then be calculated very easily.

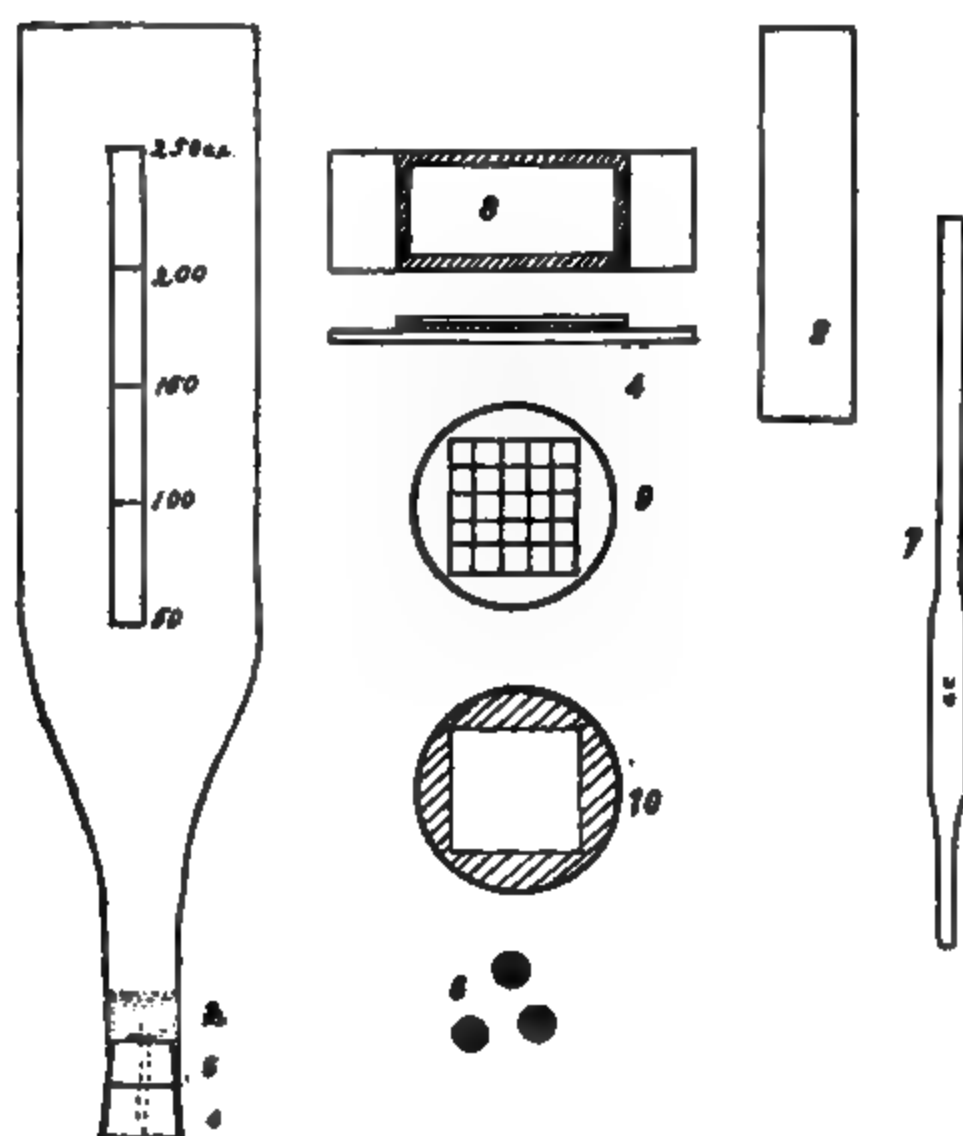
This process has many things to be said in its favor, and it is undoubtedly the best all-around method for the study of the plankton. The apparatus required is simple, inexpensive and not liable to get out of order. The process is neither long nor difficult, and if care and cleanliness are observed in the manipulation very accurate results may be obtained. Ordinarily the quantity of water operated upon is small, but there is no reason why large filters may not be used. The writer has frequently used a funnel having a neck one inch in diameter, filtering from 1,000 to 10,000 c. c. This, when used with an aspirator to hasten the filtration, has given excellent satisfaction. The chief objection to the Sedgwick-Rafter method is that delicate organisms are liable to be crushed upon the sand, and this danger is naturally somewhat greater when this aspirator is used. It is probably no greater, however, than in Reighard's net.

Recently a new apparatus has been devised for the study of the microscopical organisms, known as the planktonikrit. This is a modification of the centrifugal machine and depends upon the fact that the specific gravity of the organisms is different from that of water. It has the advantage of avoiding, to a certain degree, the crushing of the delicate infusoria, but it is somewhat inaccurate in the case of some of the lighter organisms; furthermore, it operates upon very small quantities of water.

In a complete study of the microscopical organisms, such as might be undertaken on our great lakes, for example, it would be advisable to use all three methods adopting the Sedgwick-Rafter method for general quantitative work, but using the net and centrifugal apparatus for determining the rare and delicate organisms.

As there are many lovers of the microscope who are interested in studying aquatic life, and as there are many

others connected with water-works to whom the study of algæ and infusoria would be of much value, the writer has tried to reduce the Sedgwick-Rafter method to its simplest possible elements in order that it may be more generally used. Furthermore, it is often necessary for the sanitary biologist to be provided with a portable outfit for work in the field. There are many fragile organ-



isms which will not bear transportation to the laboratory. *Uroglæna*, for example, a very important and troublesome organism found in water supplies, goes to pieces completely when kept for a short time in a stoppered bottle. It is, therefore, necessary to make the examination of water immediately after the collection of the sample.

The chief modification of the method for field work

consists in the use of a cylindrical glass funnel (fig. 1) similar to the one designed by Mr. D. D. Jackson for the Massachusetts State Board of Health, but different from it in having a capacity of 250 instead of 500 c. c. and in having graduations marked upon the sides. This funnel may be conveniently carried and its graduation renders the use of a second measuring glass unnecessary. When in use it may be supported on a wire frame, which any ingenious person can make. In place of the test-tube it has been found convenient to use tube vials (fig. 2) having square ends. These require no racks and are not easily tipped over. The pipette for washing the sand might be dispensed with if one of the tube vials was graduated, but as much depends upon accuracy in concentrating the sample it is best to use a short pipette (fig. 7). The sand (fig. 3) used in the filter should be perfectly clean and of such size that its grains will pass through a sieve having 60 meshes to the inch, but not through one having 100 meshes. Crushed quartz makes the best filtering material and should be used when obtainable. The discs of bolting cloth (fig. 6) may be easily cut out with a wad cutter. The filtered water may be used for concentrating the organisms, or it is possible to employ preservative fluids in case the microscopical examination must be deferred or it is desired to keep the specimens. The cell (fig. 8) for holding the concentrated fluid may be made by cementing a brass rim to an ordinary glass slip. It should be 50 mm. long, 20 wide and 1 mm. deep, thus holding just 1 c. c. and having a superficial area of 1,000 sq. mm.

A very simple microscope will answer for this work. A large stand is too valuable and too heavy for the rough usage in the field, and a cheap, light stand with a $\frac{1}{2}$ inch or $\frac{3}{8}$ inch objective and a No. 3 ocular will answer equally well. The ocular must be provided with a micrometer, so that the observer may count the number of organisms

in one cu. mm. of the cell. A disc of glass ruled as in fig. 9 is the best form of micrometer, but a piece of thin metal with a square cut out, as shown in fig. 10, may be substituted. In either case the square must be of such a size that it covers one sq. mm. on the stage with a given combination of objective and ocular, and a certain tube length to be found by comparison with a stage micrometer. It is an advantage to have at hand higher powers for a more thorough study of the organisms met with, but for ordinary work the powers suggested are sufficient.

All this apparatus, together with bottles for collection and note book for records may be carried in a grip sack, and this will be found generally the most convenient way. It is possible, however, to make a neat box, with compartments for holding the microscope, funnels, tube, vials, etc., and I respectfully submit this to manufacturers of microscopical supplies.—Science.

Astronomical Photography with Photomicrographic Apparatus.

A. CLIFFORD MERCER, M. D.

SYRACUSE, N. Y.

On the twentieth of October, 1892, occurred a partial eclipse of the sun, and my heliostat was placed on a shelf outside a south window. Within the room was a portrait lens of eight inches focus and a microscope in the small axial line. The substage condenser was removed and a camera connected with the eye end of the microscope tube. Such sunlight as fell on the mirror of the heliostat was reflected through the portrait lens. The portrait lens projected an image of the clouded sun's disc, about one-twelfth of an inch in diameter, in the plane usually occupied by an object on the stage of the microscope. This tiny image was itself projected by

a microscope objective of an inch and a half focus to form a second image, two inches and three-eighths in diameter, on the ground-glass of the camera. The clouds made sharp focusing impossible. Only an imperfect focus was obtained. The clock of the heliostat kept the image steadily on the ground glass.

During the eclipse sensitized plates were substituted for the ground-glass. Exposures were made when the clouds were thin enough to permit. Thus six negatives were secured. The first print shows the moon's black disc, advancing apparently from the north-east across the sun's disc, while the second shows the moon's disc, passing off to the west.

This is the first record of an attempt to use photomicrography astronomically. All of the necessary apparatus could be easily packed in a trunk. If an unaided telescope objective were used to project an image of the size obtained, a focus of twenty-one feet would be required; and the lens would have a diameter of about sixteen inches. Such an objective properly mounted would result in an instrument nearly half as large as the great Lick telescope, with its photographic objective. By using a portrait lens having a focus of fifteen or sixteen inches, a size commonly used for "cabinets" in photographers' studios, instead of the portrait lens, the apparatus will produce a negative image equal in size to that produced by the unaided Lick lens; or, leaving the portrait lens in place, the same result could be obtained by substituting for the microscope objective of one inch and a half focus, another of about double the power,—one of three-quarters of an inch focus. The Lick instrument has a tube about fifty feet long and forty-two inches in diameter, while this apparatus has two tubes less than one foot long and about one inch and six inches in diameter respectively. To the smaller tube is attached a camera with a bellows extending from one to six

feet. Stability and freedom from vibration are very easily obtained with the small and short apparatus. The difference in cost is enormous. In several respects the photomicrographic arrangement has advantages over the great Lick photographic instrument.

If, however, we turn to the matters of light and separating power, the very great superiority of the Lick objective is seen. The results given in the following tabular comparison are only approximately accurate. The loss light suffers by absorption as it passes through glass and by reflection at incident surfaces, is not taken into account;—the Lick objective consisting of three thick lenses and the photomicrographic arrangement having more than twice as many, but comparatively very thin, lenses and the mirror's reflecting surface:

	Lick Objective.	Larger Portrait Lens.	Smaller Portrait Lens.
Diameter of objective.....	33 in.	3.75 in.	2 in.
Focns of objective.....	550 in.	15 in.	8 in.
Focus divided by diameter.....	16.66	4	4
Relative value of light in first image.....	1	16	16
Size of first image.....	5.1 in	.1395 in.	.0744 in.
Total equivalent focus, 550 in- ches, divided by diameter.....	16.66	147	275
Relative value of light in final image.....	1	$\frac{1}{77}$	$\frac{1}{277}$
Time of exposure, eclipse of sun (about)	$\frac{1}{1600}$ sec.	$\frac{1}{20}$ sec.	$\frac{1}{5}$ sec.
Separating power.....	1	$\frac{1}{88}$	$\frac{1}{16.66}$

Other things being equal, separating power varies with the aperture or diameter of the objective. If the lick objective, having an aperture of thirty-three inches, could barely show a certain double star as two distinct stars, it would be impossible for any objective having an aperture of four or two inches to show such a double star as two distinct stars. A star apparently single when seen through any objective having an aperture of two

inches might be seen to consist of sixteen or seventeen stars in line, almost touching one another when seen through the Lick photographic objective. A star apparently single when seen through any objective, having an aperture of three inches and three-quarters might be seen to consist of eight or nine stars in line, almost touching one another, when seen through the Lick photographic objective. The power of resolving an apparent single star into two or more, or of showing the details of sun spots or other objects, is known as separating power. A superior correction of aberrations is now possible in lenses made of small discs of glass which are produced in great variety as to optical properties, a variety not yet realised, in large discs.—Tr. A. M. S.

Progress in Effects with the Roentgen X-Rays.

To see through a person in a metaphorical sense has been the wish of most people at some time or another, but it has now become a literal fact by means of the occult rays, popularly known as the X-rays (on account of their exact properties not being understood), discovered by Professor Roentgen of the University of Wurzburg. It seems inexplicable that with the art of photography, so highly developed as it has been for many years, and with the experiments that have been taking place in laboratories all over the world in radiant matter in vacuum tubes, that we should have had to wait for the year 1896 for this discovery to have been made practically available; it only leads us to reflect that "there are more things in heaven and earth than are dreamt of in our philosophy," and that there is yet room for fresh and startling inventions and discoveries.

The first announcement of Prof. Roentgen's discovery that rays from a Crooke's or Lennard's tube of high vacuum had a power of penetrating numerous substances,

such as wood, leather, flesh, etc., which hitherto had been classed as opaque, was received with incredulity, but the circumstantial description of the methods employed enabled persons possessing the requisite instruments to repeat the experiments and to confirm the report. Not the least important aspect of the discovery was, that it was likely to prove a valuable means of contributing to the relief of some of the ills to which flesh is heir, by exhibiting details of bony structure of the living subject, bone being opaque to these rays, while flesh is practically transparent.

Two special features are associated with these X-rays, (a) that the emulsion on an ordinary photographic dry plate is sensitive to them, and (b) that certain chemical salts become fluorescent, that is, appear aglow with light under their influence.

Let us examine these features in detail. Prof. Roentgen found that if a photographic dry plate were enclosed in a wooden box, and a coin were placed on the outside of the box with the vacuum tube above, on the tube being excited by means of an electric current the X-rays penetrated the wood, (which is practically transparent to them) but not the coin, with the result that the image of the coin appeared on the plate inside the box on its being developed. In like manner, if the hand were placed on the box, the bones being opaque to the rays were shadowed on the dry plate.

The title of photography as ordinarily understood was not applicable to these effects, and the name of radiography was, after considerable discussion, given to the process. It at once became apparent that a large field for investigation and experiment had been opened, and it was not long ere the London hospitals were employing the X-rays for the investigation of bone diseases and fractures, and for ascertaining the exact position of foreign bodies, such as bullets, shots, needles, etc., in the

flesh with the view to their easy and speediest removal.

We have already shown in this periodical the bones of the hand of an Egyptian Mummy, radiographed through the wrappings, flesh, etc., the structure being exhibited beautifully. Herewith is a radiograph of a fracture of

the Olecranon process of the elbow, and a radiograph of the human hand will appear as frontispiece next issue.

Great difficulty was experienced in the early days in penetrating deep structure; and radiographing ribs, vertebræ, etc., presented considerable difficulties, but as the

results of experiments, improvements were made in nearly all the apparatus that was necessary, and quite recently Dr. Macintyre of Glasgow, Scotland, has successfully radiographed a calculus of the kidney en situ which was subsequently found to have been precisely delineated on the operating table. The same gentleman has also successfully radiographed the ribs and vertebræ of adult men, obtaining at the same time faint outlines of important organs, particularly the heart, in one case of which an enlargement was distinctly portrayed, but we are to have further developments yet.

An interesting feature in connection with the Roentgen rays is its usefulness in detecting imitation gems both diamonds and rubies being transparent to the Roentgen rays, while imitations in glass or paste are opaque to them. Already a considerable use has been made of this aspect. The process is also exceedingly useful for examining the contents of postal packets, anything of a metallic nature being at once detected if contained in a wooden box. The only protection against such a revelation is of course to pack goods in a metal box through which the rays will not penetrate. It is rumoured that instruments are already in use in the General Post Office, London, for examining packets and the English War Department has invested in a considerable number of sets with a view to locating bullets on the battle field and so saving the painful and tedious operation of probing.

THE FLUORESCENT SCREEN:—It was remarked that under the influence of the X rays certain chemical salts have the power of becoming brilliantly illuminated and of rendering visible objects which are opaque to the rays that are interposed between the vacuum tube and the fluorescent screen. For instance, if the hand be placed between the fluorescent screen and the vacuum tube the bones will be distinctly shadowed on the screen while the flesh will be almost transparent, if the body be interposed

the ribs and vertebrae will be distinctly visible. Several materials have been suggested for the manufacture of these screens but probably the most successful has been Platino-cyanide of Potassium. This salt, however, varies very considerably in its fluorescent properties and quantities from the same manufacturer purchased at separate times do not yield uniform results. The method of preparation is as follows: The Platino-cyanide is ground as finely as possible with a pestle and mortar. It is then mixed with weak clear gum water and spread evenly upon a thin sheet of cardboard. One coat alone at a time should be given and allowed to dry; two or three coats are usually sufficient. Owing to the expense of the material and the chances of failure in preparing, it has usually been found more economical to purchase ready made screens. Calcium tungstate was the material suggested by Edison for these screens but it does not compare favorably with Platino-cyanide of Potassium.

A new screen has recently been placed on the market by Watson & Sons, London, which surpasses in brilliance others that have been so far made. The material is a secret preparation but with a good focus tube it enables the bones (ribs, vertebrae, etc.) of an adult person to be seen clearly.

APPARATUS:—At the outset extravagant rumors were set afloat as to the cost of the necessary instruments, but the outfit has now been reduced to a battery, an induction coil and a vacuum tube.

Additional but not absolutely necessary apparatus, would be a holder for the tube, and a fluorescent screen. The battery may consist of either Bunsen's or Grove's bells or a 4 cell accumulator giving 8 volts and a current of about 8 amperes.

THE COIL:—A Ruhmkorff Induction Coil giving a 3 inch spark only is sufficient for obtaining Radiographs of the arm, leg, etc. but if deeper structures are to be dealt with

it is well to have a coil giving a greater length of spark, say 6 inches. The tube is much more brilliantly illuminated with such a coil, exposure is shortened and deep structures more easily penetrated. There is another reason also why so large a coil as a 6 inch should be taken. With use the vacuum of a tube becomes higher and is consequently more difficult to excite. Warming with a spirit lamp will reduce the vacuum but it is not nearly so satisfactory as being able to excite the tube direct from the coil.

THE TUBE:—More failures in working have been due to defective tubes than to anything else, in fact a large majority of the tubes that have been sent out have been absolutely worthless. It is unwise to buy any tube without a guarantee of its suitability and perfection in working and where such a guarantee is obtained the price is usually somewhat high. Still it is better to pay a fair price for a good article than to have several unsatisfactory tubes at a low price.

As tubes are somewhat liable to damage it is well to be provided with two or three. No absolute statement can be made as to the length of life of a tube. The writer has one in use which has been constantly employed for the past three months and is as good as ever, while others have sometimes failed in some particular after a very short period of use. We have experimented with tubes by all makers and have spared no expense in having the latest patterns as they have been issued, but in our hands the focus tube as manufactured by W. Watson & Sons surpasses every other kind both for the fluorescent screen and for radiographic effects.

There is no doubt that the whole process is in its infancy and time alone will show in which direction further successful progress in the methods will be made. Supplementary apparatus will also appear to augment its usefulness.

EDITORIAL.

Laboratory.—The best equipped and most complete bacteriological laboratory on the Pacific coast is owned and conducted by Prof. S. M. Mouser, at 707 Bush street, San Francisco. Professor Mouser has devoted many years of his life to the study of this comparatively recent, but rapidly growing science. He has secured all the latest instruments and scientific appliances, and is constantly in receipt of all the important pathogenic bacilli cultures for experimental, teaching and therapeutic purposes. It is gratifying to note that the Professor's labors are appreciated, notwithstanding that many of our ancient confreres are still scoffing at the science. Besides being Professor of Bacteriology and Pathology in the College of Physicians and Surgeons of San Francisco, Dr. Mouser daily conducts large private classes in bacteriology and pathology at his laboratory, as well as doing private analytical work for the profession on the coast.

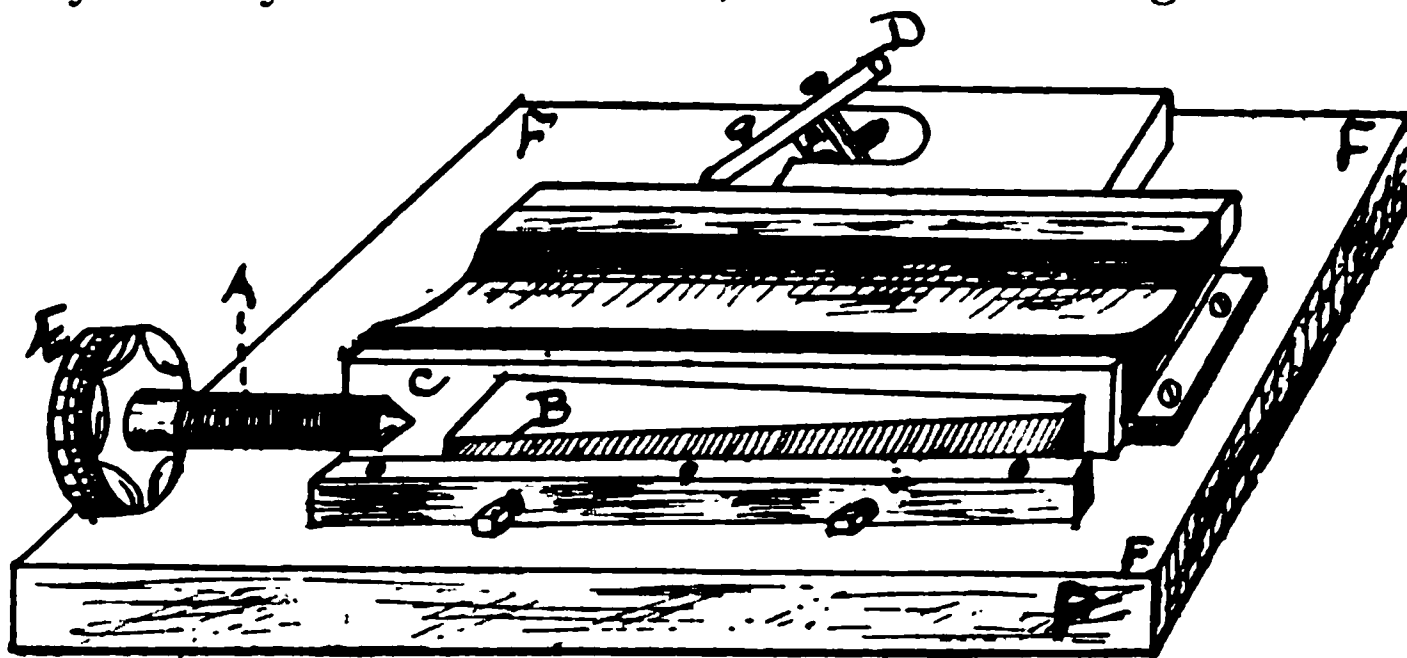
The Danger from Bovine Tuberculosis.—Dr. W. L. West of Ellsworth, Me., has reported to Dr. G. H. Bailey that two children of a man named Luther Bridges have recently died of tuberculosis, due to drinking milk from a cow which was found, when killed, to be the subject of extensive tubercular disease, localized in the udder. Five of Bridges' nine children are suffering from pulmonary tuberculosis and several are now, according to the report, fatally ill.

MICROSCOPICAL APPARATUS.

Micrometer Rulings.—On May 21st, 1897, there was exhibited before the New York Microscopical Society a very simple piece of mechanism for producing fine rulings on glass. The inventions hitherto employed for this purpose have been elaborate and costly, while on this article from the labor of an ordinary machinist the cost was less than five dollars. To rule lines accurately up to fifty

thousand to the inch and more by such an appliance seems almost incredible.

The inventor, Rev. D. W. Smith, of Brooklyn, N. Y., having need of some work of this kind to assist him in certain experiments, with a few pieces of metal and glass evolved the machine referred to. He states that, beyond forty or fifty lines to the inch, the task of ruling lies more



DESCRIPTION OF FIGURE.

A.—Micrometer screw operating upon the base of the movable wedge.

B.—Movable wedge, adjusted by set screws working in contact with strips of plate glass.

C.—Brass block, having only lateral movement caused by the thrust of the wedge

D.—Diamond carrier, easily adjusted to any position and weight necessary for any degree of cutting. and moved laterally by the brass block and longitudinally by hand.

E.—Graduated drum upon the micrometer screw.

F, F.—Iron base supporting the entire apparatus.

The following parts, for distinctness, are not represented in the figure A broad clamping nut supporting the micrometer screw; an index for the graduated drum; and the retaining springs holding the movable portions in contact.

in the proper selection of diamond points or crystals, necessary for lines of the required fineness, than in the accuracy of the machine.

The principle involved is that of a screw, operating upon a wedge of brass, moving the latter longitudinally on the supported bed. The screw contains sixty threads to the inch, which number is by no means an arbitrary one. For the wedge is capable of adjustment by means of set screws

which serve to correct its movements to correspond with the inch or millimeter to be ruled. In this case one revolution of the screw moves the wedge so that its lateral displacement is equal to one one-thousandth of an inch. This lateral displacement of the moving wedge operates on a block of brass resting on three points projecting from its base. By the side of this block of brass is operated the diamond carrier. The points of contact for the entire system of screw, wedge, block of brass and diamond carrier, operate upon pieces of plate glass—plate glass strips where contact points move on wedge and block, and plate glass bed resting on an iron base, which supports the longitudinal and lateral movements of the block of brass and the diamond carrier. This give a smooth and accurate motion to all the working parts, which could be otherwise obtained only by expensive and carefully polished steel surfaces.

This is a general description of the first working model so far as is known, using the principle of the wedge as a means of adjustment and correction, and of imparting the motion of a decreasing gear from the screw which is necessary for such work. A considerable motion of the screw is thus given for minute divisions, thereby ensuring uniform and accurate rulings.

The device for carrying the diamond, as first used, was a single carriage, moved back and forth by hand along the glass bed plate, and held in its place to the brass block by means of contact springs. Afterwards for convenience, a triple link carriage was made, that is, three separate parts hung by three trunnion points of hardened steel accurately turned. Though much more scientific and easier of use the results, up to thirty or forty thousand lines, was hardly worth the trouble of its construction, save the chance of any disturbance of the diamond point by accidental handling of the diamond during ruling.

With a little more trouble the entire arrangement could be easily adjusted to become entirely automatic in its movements, whereas in the present model the move-

ment of the screw and that of the diamond carrier requires separate and distinct operations. With the screw thus connected a motion is given to the diamond covering a space of about one-fifth of an inch in width. Thus a screw sixteen inches long would give movement enough to rule a spectrum band one inch square.

MICROSCOPICAL MANIPULATION.

Drinking Water.—Schumburg has thoroughly gone into all known methods of purifying drinking water, and finds that bromine is the only disinfectant which can be removed after serving its purpose, without spoiling the appearance and taste of the water. The quantity of bromine used is very small; 1 kilogramme is sufficient to sterilize 16,000 litres of water. The author uses the bromine in the following solution:—Water, 100; potassium bromide, 20; bromine, 20. 0.2 C.c. of this solution is sufficient to sterilize in five minutes 1 litre of water from the river Spree. The calcium salts or ammonia of very impure river or surface water use up some of the bromine before it has had time to develop its disinfectant properties. In such cases enough must be added to cause a slight yellow coloration of the water, which should last at least half a minute. The 0.2 C.c. of bromine solution may be removed by adding an equal quantity of 9 per cent ammonia.—*Pharm. Zeitg.*, xlii., 174.

BACTERIOLOGY.

Baldness.—Dr. Sabouraud, in the *Annales de Dermatologie*, firmly believes that the disease is contagious, and that barbers' instruments are the most common carriers of the contagion; but as customers come and go from one barber to another, it is difficult to trace each case to its source. Starting with the theory of the microbic origin of the disease, Sabouraud has worked out a strong chain of evidence in its support. He tells us that the typical hair of Alopecia areata is found at the edge of an advancing patch,

and is a stump of long hair that has remained in the scalp. It is club shaped, or like an interrogation point. Its diameter becomes less as we go towards the root, and its color is lost. These hairs are always a sign of an advancing patch, and are not found in old patches. The medullary (or pit) canal of these hairs is normal above, altered in the middle, and it is completely wanting at the root. The root is not bulbous and hollowed for the papilla, but in the form of a turnip. . . . Utricules that are full and closed are found among the sound hairs. They are filled with joined strata of epidermic cells, and contain in their centers, like a larva in a cocoon, compact clusters of microbes, a pure culture of the smallest bacillus known.

. . . As it grows old it may be one quarter millimeter (0.01 inch) wide and one-half to one millimeter long, and comma shaped, or bent. The young bacilli are a little swollen in the center, and their ends are blunt. . . . Each utricule contains millions of them. . . . This bacillus is regarded as the most probable cause of the disease.—*Sci. Am.*

Leprosy.—Leprosy furnishes the best opportunity for studying a parasite of a bacterial nature. The relation of the cells can be plainly shown, since they do so little damage. Regarding the phagocyte theory: As Dr. Rosenstirn says, inert substances can be taken up by the leucocytes. It has been said that the bacteria that we stain are dead; that they have a keratin-like envelope capable of dying. In several forms of leprosy they are hard to find, especially in erythematous cases. The discovery of bacteria floating free in the blood is not new. It is remarkable that they can float through the kidneys and do no damage, but they seem to take up in certain tissues; for instance, the eye-brows, and not the scalp.

It is the concensus of opinion that a leucocyte cannot pick up a bacterium unless it be dead; it being a process of digestion. The action is such that if the bacterium remained there long alive, either one or the other must die; they are so antagonistic to one another. There is no reason why the leucocyte cannot take up 30 or 40 bacilli.

Caseous Rhinitis.—During the last year or two Prof. Guarnaccia (*Archivii Italiani di Laringologia*, No. 4, 1896) has made bacteriological researches upon caseous rhinitis. These studies refer to a case observed by Massei in his clinic. Guarnaccia has demonstrated that the micro-organism found in rhinitis caseosa, which was so differently understood by Perier, Sabrazes, etc., is streptothrix alba, or Foersterii, studied by Rossi-Doria, Cohn, and Gasperini. The author was able to cultivate it in agar gelatin, bouillon, blood-serum, potatoes, and milk. Inoculations in animals were not successful. It is perfectly correct, in his opinion, to assume that the considerable amount of caseous matter is formed by the growth of the streptothrix, as is the case in muguet.—*Universal Medical Journal*.

Tuberculosis in Goats.—From the following it will be seen that the hitherto accepted theory that goats are immune to tuberculosis is not altogether correct. Bulling (*Indian Medical Record*) records a case of pulmonary tuberculosis in a goat. Both lungs were adherent, and large and small tuberculous foci were present. The author concludes that it would be well to examine into the possibility of the transmission of tuberculosis through the agency of goats, and to consume their milk only after boiling, or after the goat has been shown to be free from tuberculosis by the absence of reaction after the injection of tuberculin.

MICROSCOPICAL NOTES.

Circulation of Blood.—Most books recommend the use of a frog's foot for this purpose and give directions for accomplishing the purpose. The object may easily be attained with a small tadpole, lizzard, and with many of the larger water larvae. The latter will show the circulation all through the body. With the lizzard and tadpole, it may best be seen in the thin membranes of their tails. All that is necessary is to place the animal in a glass slip with a shallow cell and cover it.

MICROSCOPICAL SOCIETIES.

American Microscopical Society.

The 1897 Meeting.—It was held at Toledo but owing to the attraction of the A. A. A. S., and the British Association at Toronto and the lack of preparation for the meeting it proved almost an entire failure. The Toledo papers paid almost no attention to the matter and sent no reporters to the meeting. From two short notices in the Toledo Blade, however, we are able to glean the following:

Thursday August 5.—Meeting opened in the High School building with an address by the President, E. W. Claypole, upon "Microscopic Light in Geological Darkness." Only a small number of persons were present they being mostly Toledo microscopists and their friends. An informal talk or "reception" followed the address.

Friday Aug. 6.—The meeting for business commenced at 9:30 a. m., (with a dozen present), and after unimportant matters had been discussed, Prof. D. S. Kellicott of Columbus, Ohio, spoke on the "Capture and Study of Rotifers." Miss Edith J. Claypole, a daughter of the President read a technical paper on "Comparative Structure of the Digestive Tract." Francis L. Rice, of Steelton, Pa., had expected to present a "microscopic examination of steel."

Friday P. M.—No meeting. The visitors were escorted about town by citizens to see "various points of pleasure and interest."

Friday Evening.—Soiree. All the available microscopes in Toledo were brought to the Library Building and the miscellaneous public were shown the usual wonders of the invisible realm. "Every body who has any interest in these matters should avail themselves of the opportunity," was the invitation to the public. "The public except small children, is cordially invited." "There were nearly 100 instruments of all sizes the lens of some of them being extremely powerful."

Saturday Aug. 7.—The sessions closed with the election

of officers and the reading of two papers. No new persons being available for president it was thought wise to elect one of the early presidents again.

The list for 1897-8 is as follows :

President, D. S. Kellicott.

Vice-President, Mrs. S. H. Gage.

“ V. A. Moore.

Secretary, Dr. W. C. Krauss.

Treasurer, Magnus Pflaum.

Committee, Dr. D. E. Haag, Edith Claypole,
and John M. Berry.

The Secretary and Treasurer are hold-overs.

A paper was then read by Agnes M. Claypole on “Forms of Cleavage in eggs of certain Arthropods.” The other paper of like technical character was by John M. Berry of Peterboro, N. Y., on “Phagocytic Action of Leucocytes in Amphibians and Mammals.

The society then adjourned to meet at such time and place as the committee may hereafter agree upon. It seems that no invitations were received by the society for next year and no exhibits, working sessions, excursions or banquets were connected with the meeting this year. The Blade says : “While the attendance was not so large as had been anticipated the interest of those present was none the less apparent.” It also announces that one enthusiast, J. C. Smith, had come all the way from New Orleans, to attend and that there were two or three people from Fort Wayne, Ind.

Certainly the thanks of Toledo are due to the Professor Claypole and his two daughters, without whose presence the meeting would have lost largely and whose papers constitute in bulk three quarters of all the mental pabulum furnished the visitors. The Blade properly acknowledges this by saying : “Perhaps the best known microscopists in this section are Prof. Claypole and his two daughters, who are always among the leaders in any event that tends to create microscopic interest.”

Our society is indebted to Dr. D. E. Haag for securing the school room for its use and for working up the exhibi-

tion of objects at the Soiree. It appears to have shown its thankfulness by electing him a member of the Executive Committee, while the other two members earned their places by reading papers.

If the Secretary will confine the Proceedings to the actual occurrences at Toledo, we are of the opinion that his fond hope of having them out by Christmas ought to be realizable. But if he waits for absent members to write some papers with which to eek out a report, he will perhaps be delayed till next spring or summer.

NEW PUBLICATIONS.

Elementary Zoology and Laboratory Guide.—By H. E. Chapin and L. J. Rettger., Chicago, 1897, 212 pp., 145 figs. 8 vo.

In the preface, our authors significantly remark: "A teacher who expects to do no more than read the following pages is begged to close the book at once and turn his attention to more profitable things. "A teacher who would merely assign three pages in advance each day had better exchange the book for an almanac or a treatise on Chinese."

This book then is not to be memorized and recited. You are to go into the laboratory and museum and study objects of Natural History. Perchance this book will help you—that all depends on you. The book is all right: are you?

Chapters are devoted to Protozoa, Porifera, Cœlenterata, Echinodermata, Vermes, Molluscoidea, Mollusca, Arthropoda, Vertebrata, and Laboratory methods. Embryology and minute structure are not much touched upon, the scope of the book being microscopic largely. We heartily commend it to the notice of all teachers.

A few pages on the microscope contain the rudiments of knowledge needed by the beginner. Hardening and mounting media are described briefly, so is embedding, section cutting, etc.

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Parasitic Leaf-Fungi.

BY REV. ALEX. S. WILSON.

About the time when the blackberries are ripe, after a short search one can generally find a bush the leaves of which have a paler appearance than ordinary; closer inspection shows the under surfaces of the leaves flecked here and there as if with specks of soot. With the aid of a pocket lens each speck is seen to consist of tufts of little club-shaped bodies, and if we scrape some off, mount them on a slide, and place it under the microscope, we see that they are cylindrical cells, each made up of from three to eight joints, and supported by a short stalk. Their form is so characteristic that, once seen, there is no difficulty in recognizing it again. These are the telutospores of the bramble brand (*Phragmidium violaceum*), a parasitic fungus belonging to the order *Æcidiumycetes* (or *Uredines*), all of which inhabit living plants.

The leaves of various species of mint are in autumn often dotted over in like manner with dark-colored spots, due in this case to the telutospores of *Puccinia menthæ*, each composed of two joints of hemispherical form. By this two-celled character the *Puccinia* genus is distinguished from *Phragmidium*, which has telutospores usually consisting of more than three joints. On the meadow-sweet a brand, *Triphragmidium ulmariae*, occurs, having three-celled telutospores; those of the brands

which affect the bean, pea, clover, and lady's-mantle, species of *Uromyces*, are uni-cellular. *Gymnosporangium* (*Rostelia*) growing on junipers has them two-celled, closely packed, and embedded in gelatinous substance: they are prismatic, and form a compact layer in *Melampsora* infesting the leaves of the willow and sunspurge; and the species of *Coleosporium* living on the colt's-foot and eye-bright have four-celled telutospores united to form a compact, waxy stratum, surrounded by a gelatinous mass. The characters presented by their telutospores thus form the basis of the classification usually followed in this group of fungi, the spores of which, indeed, constitute the principal feature.

Telutospores are resting or winter spores; only in a few cases are they capable of immediate germination. The name derived from *telos*, "end," indicates that their production is regarded as completing the life cycle of the fungus. Unlike other spores, which on germination give rise to a branching mass of thread-like cells known as a mycelium, which is really the vegetative body of the fungus, a telutospore only develops a short filament or promycelium, on which arises small reproductive cells, the sporidia; the latter are able at once to germinate and form mycelia.

Minute yellow streaks may be observed during the latter half of the year on the leaves of all our common grasses, especially on the lower leaves, by anyone who will take the trouble to look for them. On examining these with the pocket lens they are found to be chinks in the epidermis of the leaf filled with orange-coloured dust. Under a microscope of low power, with direct light, a small piece of grass-blade so affected presents a charming appearance. The dust is seen to be composed of orange red globules, having a waxy lustre or bloom, reminding one of artificial fruits, and forming a splendid contrast to the bright green chlorophyll grains of the

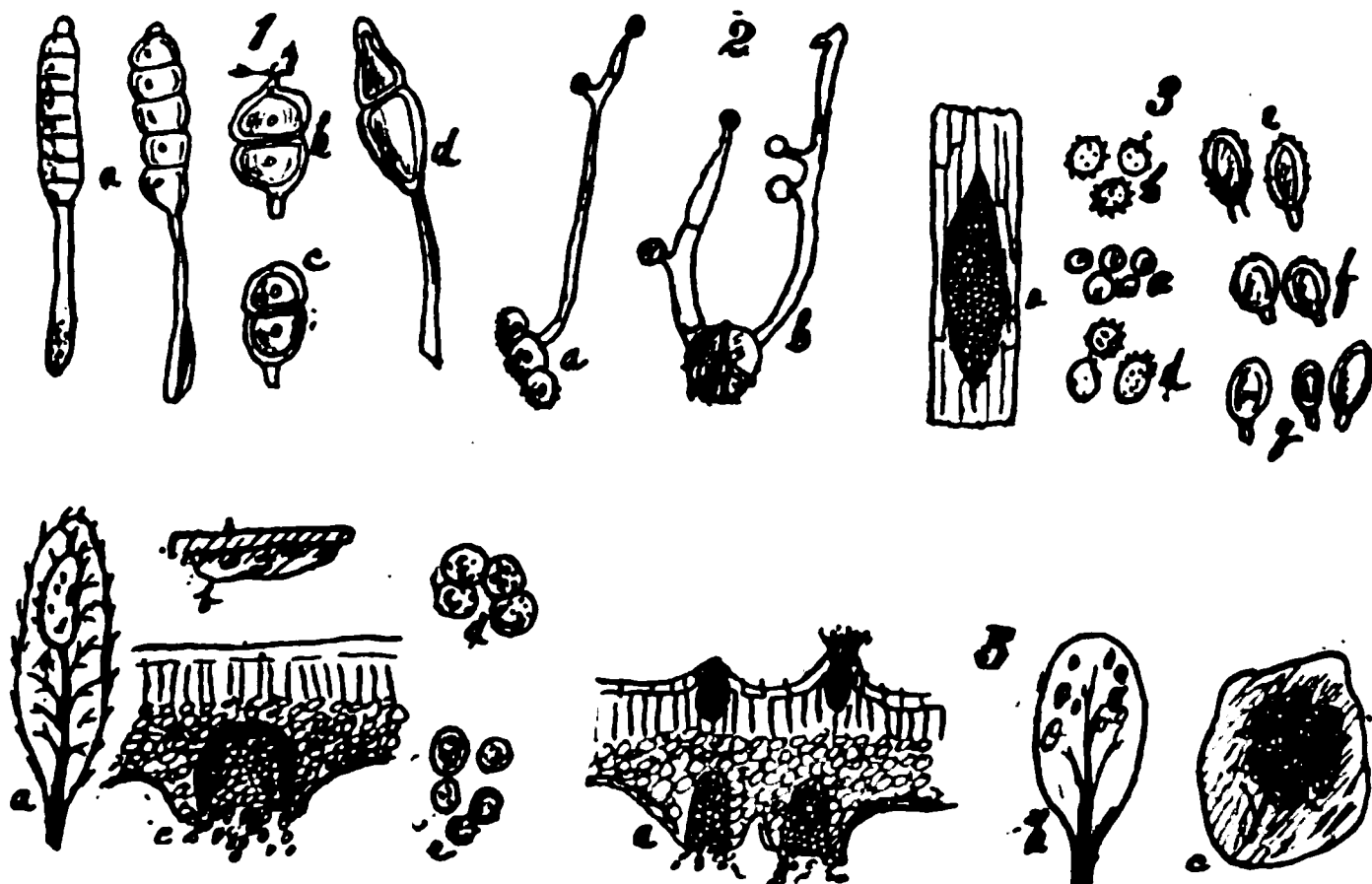
leaf. With careful focussing under a higher power, minute projections studding the surface of the spores become visible, giving them a bristly appearance. These are the summer or uredospores of a parasitic fungus now designated *Puccinia rubigo vera*, one of the corn-rusts which occasionally inflict so much damage on cereal crops. *Puccinia graminis* injures the wheat; allied species occasion the orange and scarlet patches of rust seen on the rose, barren strawberry, eye-bright, cow-wheat, sow-thistle, groundsel, thistle, harebell, nightshade, dog's mercury, and many other native plants. The name uredospore (*uro*, "I burn") has reference to the conspicuous disfigurement and often burnt appearance of leaves attacked by these fungi. Unlike telutospores, the uredospore germinates at once if placed on a suitable host, and gives rise to a filament which penetrates the epidermis and develops into a mycelium, extending through the intercellular passages of the leaf. Uredospores commonly appear somewhat earlier in the season than telutospores, though the two often grow together.

On gooseberries our readers may sometimes have remarked a bright yellow spot about the size of a sixpence. Similar spots occur on the leaves of gooseberry and currant bushes. The lens shows that they consist of a number of small round openings full of orange powder; these are the cluster-cups and æcidiospores of *Æcidium grossularia*. An exceedingly common species, *Æ. compositarum*, is found on the lower surface of the colt's foot leaf, a plant abundant on every railway embankment. Plants may possess more than one species of parasite; on the colt's-foot there also occurs a species of *Colesporium*, and nearly a score of different fungi are stated to take up their quarters on the leaves of the nettle. Each species of æcidium confines itself, as a rule, however, to plants of a particular family, or even selects its hosts from a single species; thus the æcidia of the berberry,

hawthorn, honeysuckle, Scotch fir, mountain ash, anemone, buttercup, nettle, primrose, violet, willow-herb, bedstraw, dock, and many other plants are all different and belong to distinct species. Seen with the lens the cluster-cups present the appearance of a group of miniature volcanoes. At first the æcidium fruit is a small spherical body formed beneath the epidermis of the leaf whereon it grows, which it ultimately ruptures; the æcidium itself, when ripe, bursts, and the yellow spores are discharged. The section of an æcidium shows a cup-like cavity with spores arranged in vertical rows like short strings of beads; they are developed by budding, and become detached in succession. Externally the aecidium is in most species invested by a membranous envelope, the peridium, usually cup-shaped, but occasionally, as in the cluster-cups of the pine, prolonged into a tube. The peridium may open irregularly or split up in a definite manner, giving its margin a toothed appearance. An aecidiospore can germinate when sown on a suitable host. The cluster-cups appear earlier in the season than the uredo- or telutospores, and are very often associated with smaller cups called spermogonia, which appear on the upper surface of the leaf (fig. 5, a spm.), from which issue minute spermatia, which have never been known to germinate, and are therefore generally regarded as male reproductive cells.

All the three kinds of spores above described, it must now be explained, are produced in succession by some of the Uredines on the same mycelium. The Puccinias of the mint, primrose, violet, goat's-beard, and onion develop all three forms; teluto- uredo- and aecidiospores occur on the same plant. Had we examined the bramble *Phragmidium* earlier in the season we should have found, not the many-celled telutospores, but unicellular uredo- or aecidiospores. The rose rust, *Ph. subcorticum*, and that of the barren strawberry, *Ph. fragariae*, in like

manner bear three kinds of spore on the same host. The rusts of the knot-grass, beet, geranium, and valerian, caused by species of *Uromyces*, also possess spores of three kinds. Others, like *U. alchemillæ* and *U. rumicis*, have teluto and uredo but no aecidiospores. Only telutospores are known to be produced by the Puccinias parasitic on the gout-weed, speedwell, mallow, harebell, and



DESCRIPTION OF THE FIGURES.

1. Telutospores: a, *Phragmidium violaceum*; b, *Puccinia menthæ*; *P. violarum*; d, *P. graminis*. 2. Germinating telutospores with promycelia and sporidia: a, *Phragmidium*; b, *Triphragmidium*. 3. Uredospores: a, grass blade with rust; b, spores of bramble rust; c, spores of barren strawberry; d, e, spores of corn rust; f, of rose rust; g, of thistle rust. 4. *Æcidia*: a, leaf of berberry with cluster cups; b, side view of æcidia; c, leaf of sun-spurge spotted with *Melampsora*; d, cluster cups of bedstraw. 5. Spermogonia on upper surface of leaf.

saxafrage. Uredospores are wanting in the Puccinias of the ragwort and earth-nut; telutospores are absent in the rusts of the figwort and fern, while neither the uredo nor telutospores are known which correspond with the æcidia of honeysuckle, meadow-rue, and gooseberry. The three kinds of spore are not formed simultaneously; further observations may therefore be expected to reduce the number of these exceptions. Before it was known

that a cluster-cup, a rust, and a brand might be merely successive stages of the same fungus, specific names had been assigned to each of the forms, with the result that some of these parasites have three names; and this inconvenience is still unavoidable in cases where the connection between the different stages has not yet been demonstrated.

But what invests this group of fungi with peculiar interest is the fact that many of them spend their first or aecidium-bearing stage on a different species of host-plant from that which they inhabit at a later period of their life history, when they develop uredo- and telutospores. Thus there are several kinds which produce aecidia on the leaves of firs and pines, and then migrate to plants of the Heath order. To this changing of hosts the name Heterœcism (*heter*, "other"; *oikos*, "house") has been given. Analogous phenomena are observed among animal parasites. The same organism which occasions "measles" in pork, causes the tapeworm in man while in the cat it is but a more advanced form of one that inhabits the intestines of the mouse; and the liver fluke of the sheep passes one part of the cycle of its development in the body of a pond snail. Farmers long suspected that the presence of berberry bushes in their hedges had something to do with the rust that destroyed their wheat. This idea was verified by the discovery that *Puccinia graminis* is merely a later stage in the development of *Æcidium berberidis* which infests the berberry. As the alternation of generations was first traced in this species, it is the example of heterœcism usually given in text-books, but a similar connection has been made out in many other instances. The cluster-cups of the Scotch fir belong to the same Uredine which bears teluto and uredospores on the groundsel; those of the colt's-foot correspond to telutospores on the meadow grass of *Puccinia poarum*: *Æcidium urticæ* of the nettle devel-

opes uredospores on species of *Carex*; the aecidium fruits of *Gymnosporangium caneellata* occur only on the leaves of the mountain ash and other Pomaceae, the telutospores only upon those of species of juniper. The aecidium of the buckthorn is related in the same way to *Puccinia coronata*, not uncommon on grasses. Again, the aecidia of the orchid, onion, dock; and dandelion appear in their uredo forms on various grasses and sedges, while the parasites of certain Composites seem to migrate to other plants of the same order. The corn rust, *P. rubigo vera*, turns out to be the second stage of an aecidium that grows on the leaves of *Anchusa* and other plants of the borage family.

From these examples it will be seen that in fungi of this description each generation of each species has its own form of fructification and its own peculiar host-plant. The brands of the mint and bramble are not heterœcious, but produce all three sorts of spore on the same host, or even on the same mycelium; the Uredines of the honey-suckle, meadow-rue, and gooseberry, of which only the aecidium forms are known, are likewise restricted to one species of host. In this country *Æ. grossularia* only produces aecidiospores; telutospores are stated to have been observed on the gooseberry itself on the Continent. Should this be confirmed, it would appear that the fungus in question is confined during its whole existence to the same plant, and does not, therefore, possess the heterœcismal character.

In the life history of one of these migratory fungi we have then the following phases:—The earliest form inhabits the leaves of a plant such as the berberry, where it exhausts its energies and completes its career by the production and discharge of the aecidiospores; the latter are incapable of germinating on the berberry, but on being transferred to wheat, at once germinate and form a mycelium which develops the uredo and telutospores.

The uredospores continue to propagate the uredo form of the fungus indefinitely upon the wheat, but the telutospores or sporidia arising from them will only grow mycelia if sown on the leaves of the berberry.

In not a few instances these relationships have been established by direct experiment. Dr. C. B. Plowright succeeded in producing aecidia on the hawthorn and mountain ash by infecting their leaves with telutospores taken from the juniper, and on the nettle with telutospores from a species of *Carex*. Conversely, with aecidiospores from the nettle he obtained the uredospores of *Puccinia caricis* on *Carex*, and spores from the colt's-foot cluster-cup placed on the meadow grass developed the uredo form of *P. porarum*. The aecidium of the berberry gave rise to *P. graminis* on grass, and berberry leaves infected with telutospores from the latter developed aecidia of the usual form. Check plants which in these experiments were not inoculated yielded negative results; the possibility of error was thus eliminated. It may therefore be taken as conclusively proved that many of these leaf fungi exist in alternate generations as parasites on distinct plants, with forms so unlike that the successive phases in the life cycle of one and the same fungus were long regarded as different species and classified in separate families. The brilliant orange and scarlet tints exhibited by so many Uredines are due to the presence in their cells of drops of highly-coloured oil. They differ from the Peronosporæ in their septate mycelium, and are less destructive, as the mycelium does not extend through the entire body of the host, but the damage is usually restricted to the small affected areas of the leaf. Sexual reproduction has not been observed in the Uredines; there are, however, grounds for the belief that a process of fertilization really takes place, but the consideration of this question must be reserved for another occasion.--*Knowledge*.

The Dennis Fluorometer.

WITH FRONTIS-PIECE.

It is the function of this instrument to establish, with precision, the location of any foreign object within the human organism which is impermeable or comparatively impermeable to the X-rays. In other words it is the province of the fluorometer to enable observers to form an exact and certain diagnosis in cases of presence of coins, bullets, needles, calculi or any other substance which is comparatively more dense in its fluoroscopic shadow than the subject in which it is contained. It is also its function, by eliminating the distortion of position, and the distortion caused by the divergence of the rays, to provide the surgeon with absolute and reliable measurements in cases of dislocations, fractures or any abnormal conditions of the anatomy which are susceptible of reproduction in the Roentgen shadow. To obtain a correct shadow with a view to locating an object after the parallelism of the rays is accomplished, it is absolutely necessary to have a base for measurement.

To accomplish its results, it provides: A shadow of the body or limb, is thrown on the field of the fluoroscope or, on the sensitive plate, at the same time giving data which will not only enable us to make measurements but to reproduce the exact position of the body or limb. It eliminates the distortion resulting from the radiation of the force or energy known as the X ray. The distortion caused by the position of the subject or by the radiation of the energy, having been eliminated, it provides an accurate cross-section of the body or limb, and supplies an absolutely correct right-angle, at the intersection of the lines of which the foreign object will be found in the body or limb.

The fluorometer consists in a set of carefully designed metallic angle pieces, which conform generally to the shape of the body or limb, and which are susceptible of

being squared with a simple and conveniently adjustable table. When the proper position of the cross-section is obtained, the two arms of the fluorometer will present the characteristic single shadow on the field of the fluoroscope.

Attachable to the arms of the fluorometer are two pins or sights. By means of these sights, the foreign object having been brought in line with them and the proper adjustment having been made, a correct line is produced, with the sights and foreign object coincident. By means of a metallic grating, of inch mesh, which is placed adjacent to one side of the body and consequently one side of the fluorometer, exact measurements can be made with the eye from the base line, and from points on the circumference of the body, to the foreign object.

Then, without moving the body or the fluorometer, the Crookes tube is placed directly over the subject for the purpose of obtaining the vertical line. By means of an adjustable cross-piece, which is placed over the arms, exactly the same results in a vertical way are obtained by viewing the subject from beneath, the same condition of parallelism having been produced, another set of pins having been placed in position.

While the first operation locates the foreign object on an exact cross-section, the second observation shows the exact position occupied by the foreign object in that cross section. All the elements of distortion having been eliminated, the foreign body will necessarily be at the intersection of the two lines of the right angle. The first cross-section obtained is shown by a line of India ink or iodine on the body.

Very early in the history of the X-ray it was found that it was a very deceptive guide, and that, wherever a foreign substance which was less permeable than its surroundings might be, it was certainly not in the position indicated by the so-called radiographs or skia-

graphs, and, as a consequence, two views taken at right angles, would not disclose the location of the object. It was at once apparent that the visible effect of the Roentgen ray, whether in its action on a sensitive plate or paper, or its visual effect on the fluorescent screen, is a shadow only. It must be remembered that we are dealing with a shadow, which is not only treacherous, but is lacking in the dimension of thickness. When the X ray once starts it goes straight to infinity. Thus it has happened in many cases that, while apparently a bullet or needle, for instance, was located in a certain position with reference to the anatomy, as shown by a skiagraph, it would be found that it was not at the place indicated. It is not necessary to enlarge upon this branch of the distortion, for it is familiar not only to every experimenter on the lines of the Roentgen rays, but to every surgeon who has made a skiagraph the basis of exploration.

The only practical solution of the difficulty is to establish a definite cross section of the patient by means of angle pieces, which would be less permeable than any portion of the subject, and which could be made to retain their relative position to the subject, and with the parallelism of the rays through the process of producing the angles. Having established this cross-section, it was found that it was desirable that it should be formed in close proximity to the foreign object, which had been superficially located by means of the fluoroscope. An appliance was perfected which conforms in a general way to the shape of the body, the neck, the head, the foot or the limb, and which at the same time preserves the position of the body squarely in its relation with an adjustable table. This adjustable table is extremely simple, and is so arranged that when the patient is placed in the position desired, the fluorometer will rest in a groove on the table, in one case, and an attachment of the table in the other. Then the desired position having thus been

obtained and secured, as shown in the illustration, patient and fluorometer are quickly brought into such a

position relatively to the source of energy that it shows only a thin, characteristic line on the field of the fluoroscope. Now, if a line of India ink is drawn between the

arms of the fluorometer on the subject, the exact cross-section of the patient, as shown on the fluoroscope, will be made manifest. If, therefore, the cross-section is established very close to the foreign object, it will be seen at once that the first difficulty has been surmounted; the object has been located in close juxtaposition to a thin cross-section of the body or limb.

Attachable to the table is a metallic grating with meshes of exactly one inch. This grating, when in position, is also square with reference to the table upon which the patient is placed, and the normal position is close to the side of the patient, opposite to the source of energy. The fluoroscope is placed against this grating, and it will be seen at once that measuring from any point desirable, on the surface of the patient to the foreign object, is but the matter of a moment. Just here two movable pins on the arms of the fluorometer appliance come into use. These pins are placed equidistant from the base of the fluorometer (which is, of course, squared with the table). Then when the table, with its patient, is adjusted, so that the pins or "sights" coincide with the foreign object, it will be known that all three are in the parallelism of the rays, and that the characteristic distortion, caused by the angle of the rays, has been eliminated. Measurements, taken with the eye by means of a metallic grating, will thus enable the surgeon to chart unerringly the position of the object with reference to the surface of the body which contains it.

How far "in" from the surface of the body it may be, however, is, at this point, a mystery. Now, without moving the patient or disturbing the position of the fluorometer, the second observation is taken.

For convenience in using the fluoroscope, a section of the top of the table is removable, and a proper fluorometric appliance substituted, by means of which the second right line of the right angle is determined. This

aperture in the table is also provided with the metallic grating, and the fluorometer is provided with an attach-

ment which closes the side of the instrument which was open during the first observation. Now, when the surgeon takes a position below the table, he obtains a view

which is exactly at right angles with the first. The pins are again brought into use, and the table, patient and fluorometer, together, brought into parallelism with the rays, the tube having now been placed over the patient, as shown on the opposite page, instead of the side. The position of the foreign object again, with reference to the points on the cross-section of the subject and with reference to certain points on the fluorometer, is at once charted by the aid of the meshes of the metallic grating.

Necessarily, the foreign object must be situated at the point where the two lines coincide, the distortion caused by position, also the distortion caused by the angle of the ray having been eliminate. Where that point is, can, of course, be at once ascertained by measurement on the surface of the body.

In the case of a bullet in the brain cavity elements of uncertainty of location, having in view the desirability of a possible operation for its removal, become very grave. A very slight variation of the position occupied by the head will produce a distortion which would preclude successful exploration. By means of the fluorometer the position of a foreign object in the brain cavity is ascertained with precision exactly as in the case of the body already given: it becomes merely a matter of cross-sections and surface measurements.

In the case of a bullet in the shoulder there is the possible difficulty of distinguishing a foreign object by examining the shadow thrown transversely to the body. With this system, however, the difficulty vanishes. Baring the shoulder, the appliance is fixed directly over the center of the foreign object, it having been disclosed by superficial view. The body is then brought into such a position that the appliance shows only the characteristic thin vertical line on the field of the fluoroscope. A line of India ink is then drawn across the shoulders to indicate the cross-section obtained. Then removing the

appliance and moving the shoulder slightly, perhaps an inch, the instrument is placed directly over the foreign

substance and brought within the parallelism of the rays. Again the India ink brush is brought into requisition and another cross-section indicated, intersecting the other at some point on the surface.

At this juncture, the metallic grating is brought into use. At the point where the two lines intersect is placed a bit of metal. Then with the grating the distance down to the point occupied by the foreign substance, which is necessarily directly under, the point of intersection is measured, the line being projected parallel with the base line of the fluorometer.

The Sporular Development of the *Amoeba Villosa*.

By J. C. SMITH,

NEW ORLEANS, LA.

[Read before the A. M. Society, 1897.]

In April, 1897, the writer secured some decayed leaves from a pond in the Audubon park in New Orleans, and on scraping a portion from one of the leaves, placed it under a cover-glass, and then examining it with a $\frac{1}{4}$ inch objective, the field was seen to be filled with a number of *Amœba villosa*, Leidy. Some of the specimens were active, some were apparently on the threshold of encystment, while others had already entered that state. The field, fortunately, was entirely free from other forms of *Amœba* as well as of the troublesome *Paramœcium*.

For awhile the field was thoroughly examined, and the writer noticing something unusual about the *Amœba*, concentrated his attention on one of the forms that had become quiet, and evidently about to become encysted. This specimen measured 1-125 inch, displayed the posterior well covered with the villous processes which are diagnostic of this species. The endoplasm contained a number of linear bodies and some food-balls already changed in color. The contractile vesicle was large and active, and instead of the usual nucleus, there were from ten to fifteen nuclear looking bodies that moved freely in the endoplasm in unison with a slight contraction and expansion of the body. These nuclear looking bodies were evenly dis-

persed, of a bluish tint, globular, very granular and in size varied from 1-2750 to 1-1800 inch. The slight contraction of the body became fainter, and in about one hour there was a rapid movement of the contents of this specimen, to the posterior extremity, and at the same time a rupture of the seemingly dense ectoplasm of this part. A number of the nuclear looking bodies, in company with the linear bodies and food-balls were ejected from the body with considerable force, sending them a distance from the body equalling one-half of its long diameter. The Amœba now seemed to collapse and the contractile vesicle disappeared.

My attention was now confined to the nuclear-looking bodies that lay scattered about. In the course of a few minutes, the granules contained in these bodies became partially concentrated in one place in contact with the ectoplasm, and was of a deeper blue in color. This concentration of the granules left more than one-half of each body almost clear and transparent, and in this clear space there appeared simultaneously with the concentration, a very minute but distinct pulsating vesicle. In a short while a slight movement of the body was detected and there appeared a flagellum equalling in length from four to five of the body's diameters and was directed stiffly forward. The body now became very active and in a few seconds darted off in a rapid chase about the field, in an aimless manner, reminding the writer of the zoospores of the *Achlya prolifera*.

Casting a glance at the other free nuclear-looking bodies, it was seen that most of them were undergoing the same change, and they were kept under observation until they had all disappeared from the field, in the same manner. It was impossible to follow any one of these zoospores, as the field had become filled with them.

The writer now confined his attention to one of the encysted Amœba. The one selected measured 1-250

inch, possessed no trace of a contractile vesicle, no food-balls, a few of the linear bodies, some of the nuclear-looking bodies and nothing that could be differentiated as the original nucleus. The nuclear-looking bodies were granular, as the ones cited above, and instead of being free in the endoplasm, were congregated in five spherical masses, each mass being composed of from four to six units and was enclosed in a very distinct membrane, which was made even more distinct by adherent granules.

In a short while and without any apparent movement of the body, three of these spherical masses were thrown out with some force; the fissure in the ectoplasm of the encysted amoeba was not closed; and the whole form collapsed, still containing two of the masses. In about fifteen minutes after being ejected, the membranous coverings of the units were ruptured and the contained nuclear-looking bodies were freed. The average size and appearance of these bodies were the same as the ones seen discharged from the amoeba first recorded. In the course of a few minutes they were seen to go through identically the same phenomena as was observed to take place with the one first mentioned. The field was now filled with these zoospores, and being free from all other forms of life, offered a good opportunity for further study.

In about three hours after beginning the observation, some of the zoospores had slackened their movements, would come to a halt for a short while, and then start off again; a number were less active than the rest and in a short while became quiescent. Selecting a quiet specimen that measured 1-2000 inch and using a 1 objective it could be distinctly seen to elongate itself and then resume its original size; would throw out a single minute lobate process now from one side and again from the other side. The dark blue mass of aggregated granules first observed in the nuclear-looking bodies after they had been ejected from the amoeba, had become

much smaller and now represented the nucleus itself. The contractile vesicle was very distinct and the intervals between diastole and systole were short. This extrusion of lobate processes was witnessed for some time, and it was noticed that there was no change in the position of the young amoeba, but that after awhile it retained the elongate form and would throw out pseudopodia from all parts of its body, that would at times, exceed the length of the zooid. At these times it had the appearance of a minute *Amoeba proteus*, many of the forms now measured as much as 1-900 inch, without the pseudopodia. The hour being late, the slide was carefully prepared and put away with a view to continuing the observation later.

On again resuming the observation, nineteen hours afterwards, the field was found strewn with a very large number of small and active *Amoeba* that differed from the larger forms of *Amoeba villosa* only in the absence of the villous processes. The endoplasm was slightly granular, the nuclei and contractile vesicles as distinct as in the large forms. They were freely moving about and extruded only the lobate processes. Measurements showed them to range from 1-800 to 1-550 inch. In two places on the slide were a number of forms, from ten to fifteen, closely huddled together, as if dropped in a mass at that place. In size and shape they were the same as the free moving ones; the nuclei, contractile vesicles and anterior clear spaces being exceedingly distinct. They had a slight movement on and alongside of each other, without seeming to increase the space occupied by them. They would remind one of a litter of kittens a day or two old. In speculating on this phenomenon, one could come to the conclusion that those nuclear-looking bodies that remained in the *Amoeba* after a part had been ejected, were developed within the confines of the body, and were freed only after the dissolution of the firm ecto-

plasm, and in this way the clusters of amoeba were produced. The slide was now again laid aside, and on again resuming the observations eighteen hours after, very few forms were found, and they differed in no way from the forms seen the evening before. If food could have been supplied the observation could perhaps have been extended so as to witness the full development of these young forms.

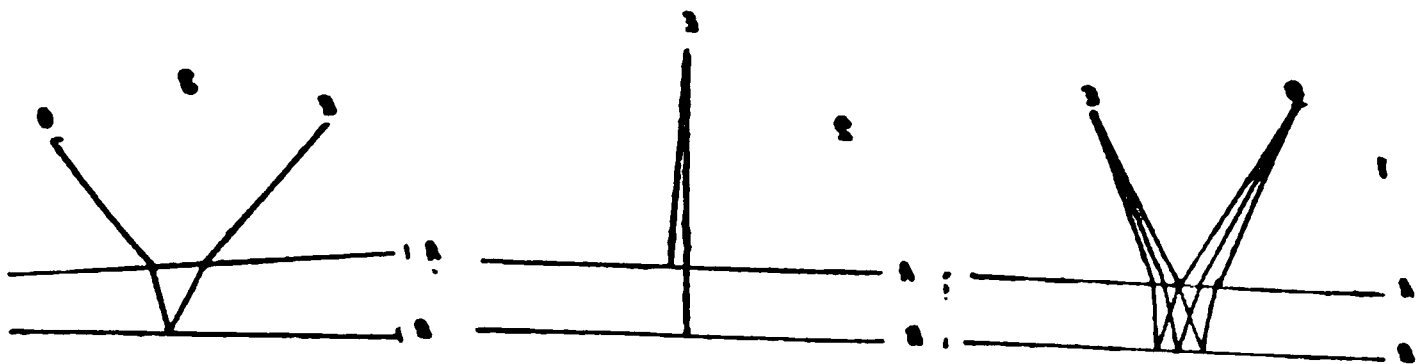
To make this history of the sporular development of the *Amoeba villosa* (and by inference all amoeba) complete, there is only one essential requisite, and that is to trace the origin of the nuclear-looking bodies to the nucleus.

Multiple Images in Mirrors.

By WM. BALFOUR STOKES.

(Read before the Quekett Club, December 18th, 1896.)

The origin of multiple images in plate-glass mirrors, and their behaviour, seems to have attracted but little



notice among microscopists. They have been noted, and a partial remedy has been prescribed, but their origin seems to have been either too simple or too complex for explanation.

When attention has been called to these images, simple, and I believe efficient, reasons have been given; but their authors did not explain the behaviour of the images when the mirror is revolved.

A figure will best show my own idea as to their origin. In Fig. 1, A is the glass surface, B the silver surface, O the object, and E the eye.

In the direction 1, 2, 3, appear the first three images. No. 1 is from the glass surface, No. 2 is from the silver surface, and No. 3 is from the silver and *air* surfaces.

Move a card along A towards 1, and No. 3 disappears first, No. 2 immediately after, and No. 1 when the card reaches that point. So much for their origin.

It will be asked, perhaps, how the images can alter their position when the mirror is revolved in the plane of A. They cannot. The mirror A B has parallel surfaces. Microscope mirrors and most plate-glass mirrors are not parallelised, but are, at the best, "optically" flattened, and may be regarded as wedges.

It is then easily seen how images approximate and retire when the mirror is revolved.

Let us give surfaces A and B an inclination of 1° (Fig. 2). Then viewing a small object at E (close to the eye) one image appears towards 1, *i.e.*, at right angles to A, and another in the direction E 2— $1\frac{1}{2}^\circ$ from E 1, which, after being refracted to 1° in the glass, is reflected at right angles from surface B.

There is another image nearer the letter A, but, as it follows the same laws apparently as the others, save that it is a real double reflection, we need not consider it. If this mirror is revolved in the plane of A, of course No. 1 image will remain still. No. 2 and subsequent images will revolve with the mirror round No. 1. If we exaggerate this wedge shape of our mirror, we can see that at a peculiar angle these images can be made to superimpose. Let the signs be as before (Fig. 3) and the images whose rays pass respectively from O to 1 and 2' will be reflected to E as one image. I should imagine the third image to arrive at E through 1, but I have not yet worked this out. Of course, placing the eye at O and the object at E would be equivalent to revolving the mirror. The images vary slightly in size owing to their various distances.

No. 2 is the brightest except at great obliquity.

EDITORIAL.

Formaldehyde.—The credit of the discovery of the powerful antiseptic properties of formaldehyde and its practical application is due to A. Frillat, who in 1888 first noticed its preserving action on samples of wine, and in 1891 made public his experiments, showing it to possess antiseptic properties much superior to all non-toxic organic antiseptics then known.

Typhoid Fever.—Water drawn from an abandoned well has given rise to several cases of typhoid fever near Rye Beach, N. Y. A party consisting of half a dozen persons went into camp near that place and drank water from it. The whole party immediately became ill, and two of the members have since died.

Fire-Blight.—This is now supposed to be due to a bacterium which enters the plant through the tender parts of the tissue, like the flower-buds or young leaf-buds as they unfold, and spreads down through the branches. When it appears on the main branches it is often called "body blight," and its presence is marked by brown and lifeless patches which become sunken. Wherever the blight appears the limbs should be cut off at once below the point where the infection has reached, and as a precaution against the spread of the disease the prunings should be burned.

MICROSCOPICAL APPARATUS.

The Micromotoscope—Is a kinetoscope for photographing cell life in motion, as seen in the microscopic field. The pictures are taken by the gelatine film at from 5,000 to 15,000 magnifications, at the rate of from 1,600 to 3,500 per minute. The images being magnified thousands of times when projected upon a screen, the views of some of the families of microbes are very realistic. It has been learned that some of them act as if intelligent. The photographs of the blood in circulation in the thinnest part of the ears and webs of the fingers, showing the capillary

and arterial motion and the changes going on in the white cells, are of great interest. They indicate something of the nature of life and disease. The stream of circulating human blood is so swift that the eye cannot keep pace with it, and the changes in the white blood cells are correspondingly rapid. Some of the pictures show a white cell on the fast moving stream, like a white cap on the sea, constantly changing its shape. It throws out or takes in its arms like an octopus, seizing the microbes in its path. In disease this movement of the arms takes place with much less energy than in health. These pictures cannot fail to be of great value in the study of diseases. The micromotoscope will greatly aid in the investigation of phenomena of action of ameboid life in water.—*Elect. Age*.

MICROSCOPICAL MANIPULATION.

Mounting Chara.—A. Flatters finds that the fruit of chara makes a good slide when mounted in glycerin jelly. After cleaning he places it in 92 per cent alcohol for several hours, then transfers into a mixture of equal parts of spirit and glycerin for several hours longer, after which he pours off nearly all of the mixture and adds pure glycerin at intervals till the glycerin becomes concentrated. Finally the object is mounted in glycerin jelly in a cavity slip just deep enough to take it without pressure. A second method is to mount in balsam, as follows:—After cleaning, graduate through 25 per cent, 50 per cent, to 92 percent alcohol and allow to stand in the last strength for several hours. Take a tube and put in it oil of cloves. On the top of the oil pour a little absolute alcohol. Immerse the specimen gently in the alcohol and allow it to sink to the bottom of the tube. When clear mount in balsam and benzole. If transferred direct from the spirit into oil of cloves, objects will shrivel and be spoiled, hence the necessity of the graduating method. To see the antheridia properly, sections should be made.—*Science Gossip*, iv., 88.

Vegetable Sections.—The best results are obtained by first bleaching the tissues, and the best agent for this pur-

pose is Labarroque's solution (liquor sodæ chlorinata) of the U. S. P. Put the sections in the liquor and leave until every trace of color is removed. The time will vary according to the nature of the tissue, thickness of section, etc. When bleached, wash the sections by allowing a gentle stream of water to flow over them until they no longer smell of the liquor, then put them in distilled water carrying one minim of nitric acid, c. p., to the ounce. Let remain for a few moments, then transfer to absolute alcohol where they should remain one hour, before passing to the staining baths. Except for special demonstrations where carmine, picro carmine, xanthoxilin, etc., are required, the writer prefers the aniline colors.

BACTERIOLOGY.

A Sweet Corn Bacillus.—Mr. F. C. Stewart, is studying a new bacterial disease of sweet corn. The plants wilt and dry up, although the leaves do not roll as they do when they die from lack of moisture. In young plants death occurs in a few days, but the disease requires from two to four weeks to run its course in older plants. Externally affected plants appear sound, but when split the fibro-vascular bundles are found gorged with a yellow substance. When a diseased stalk is cut crosswise there exudes from the ends in yellow viscid drops a substance composed of immense numbers of short bacilli. The disease may attack the plants at any stage of growth, but is the most virulent about the time when the ears are forming. It does not spread from an initial centre, but is found scattered through the field. Diseased plants frequently occur in the same hill with healthy ones. It is found in all kinds of soil, and seems to prefer the early dwarf varieties of sweet corn.—*Garden and Forest*.

Flavoring Micrococcus of Butter.—It was a remarkable discovery, when, in April, 1896, Simeon C. Keith was studying the effects of various bacteria upon cream, and in the course of his experiments he isolated a micrococcus that was found to produce a decided butter flavor and aro-

ma when grown in milk or cream. This proved to be a new species, for which he proposed the name *Micrococcus butyri-aromafaciens*.

It has always been the custom to allow cream to sour or "ripen" before churning it for butter, because after this process the butter comes better and more quickly, is of better texture and flavor, and keeps better than butter made from sweet cream. Lord Lister and Pasteur, many years ago, showed that the souring of milk and cream is due to minute micro-organisms. It remained for Professor Vilhelm Storch, of Copenhagen, however, to introduce the use of pure cultures of milk-souring bacteria in butter making. Storch isolated three species that impart especially fine flavors to butter.

A similar line of work was taken up by Professor Weigmann, at Kiel, in Germany, and by Professor H. W. Conn, of Wesleyan University, in the United States.

Of the bacteria that have been described as producing a beneficial effect in the ripening of cream, *Micrococcus butyri-aromafaciens* most nearly resembles Conn's *Bacillus* No. 41 in its effects upon milk, but it differs in its morphological and in many of its physiological characters. It is a micrococcus growing at 37 degrees and 20 degrees C. It liquefies gelatin slowly, and does not grow well on potato. Recent cultures on gelatin seem to show that the organism has lost to a considerable extent its power to liquefy gelatin during a year's cultivation.

The culture of the micrococcus for use in creameries is propagated in bouillon in Fernbach flasks (broad flasks so constructed that a large surface of liquid is presented to the air). When ready for shipment, the culture is transferred to sterilized bottles under aseptic conditions and hermetically sealed by means of sterilized corks and melted paraffin. Put up in this way, the culture may be kept for an indefinite time without danger of infection by any other organism, but in the sealed bottles the micrococcus loses its vitality so rapidly that after eight days it will no longer produce the best results. Experiments made on a commercial scale show that cream ripened with the aid of

fresh, pure cultures of this organism produces generally better butter than the same cream ripened in the usual way.

The general characters are these: A micrococcus occurring generally in pairs; 0·5 to 0·7 thousandth of a millimeter in diameter, occasionally reaching 1; non-motile; no spores; grows rapidly at 37 degrees and 20 degrees C.; aerobic; slow liquefier of gelatin; non-chromogenic(white); stains well with carbol-fuchsin.—*Popular Science News*.

The Bacillus Icteroides.—Is a small rod with rounded ends, united by pairs in cultures, from two to four millimeters in length, being three times as long as broad. It grows readily in all the ordinary culture media, and is easily stained by the usual solutions used for such purposes. "When the colonies are grown in the incubator they do not present marked differences from other species of microbes; they are rounded, of a slightly irridescent gray color, transparent, even in surface, and regular in outline. But if the colonies are allowed to evolve at a temperature of 20 degrees, to 22 degrees C., they look like drops of milk, opaque, projecting, and with pearly reflections." By exposing cultures for twelve hours in an incubator and then to the temperature of the air for the same length of time, they show themselves as constructed with a flat nucleus, transparent and azure, with a prominent peripheral circle that is opaque. This, the discoverer claims will distinguish the bacillus from all previously known varieties. "It is a facultative anaerobe; ferments glucose and saccharose; very resistant to drying; dies in water at 60 degrees, or after exposure to sunlight for seven hours, and lives for a long time in salt water."

Microbe of Ambergris.—According to professor Beauregard, the intestinal concretions of the cachalot are caused by a microbe very similar to the comma bacillus of cholera. Here is a new field for the enterprising pharmacist; he might inoculate a few sperm whales in confinement and patiently await the formation of the calculi. The difficulty is, as usual, first to catch the cachalot.

MEDICAL MICROSCOPY.

Yellow Fever.—Walter Barker, U. S. Consul at Sagua la Grande, Cuba, reports to Surgeon General Wyman, that two of the five warehouses used for storing sugar before shipment to the United States are being used as hospitals for yellow fever and other infectious diseases among Spanish soldiers.

Typhoid Fever.—The serum test of typhoid fever has been applied to the detection of typhoid infection in water by Dr. Waytt Johnson, of Montreal, bacteriologist to the Provincial Board of Health, who has described his methods and promising results before the Montreal Medico-Chirurgical Society.

MICROSCOPICAL NOTES.

It is difficult to freeze a germ to death; but boiling quickly destroys all micro-organisms.

Make it your business to get rid of the soil where germs may grow, and the germs will seek other pastures.

Antiseptics are excellent remedies for some one else to rely upon. Better is hot water and plenty of good soap and sapolio than a solution of bichloride of mercury or carbolic acid.

Professor Virchow, has been elected a foreign associate of the Paris Academy of Sciences in the place of the late Dr. Tchebitchef.

The Prussian government will assist the fresh-water biological station at Plon after October, 1898.

Pasteur.—September, 29, 1897, was the second anniversary of Pasteur's death, and it was fittingly remembered at the Institute.

Sanitation.—A proprietor of a barber shop has very justly been fined £ 5 and costs for attending to his business while still passing through the peeling stage of scarlet fever.

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PUBLICATION ANNOUNCEMENT.

The Journal will in 1898 be a 16-pp. illustrated magazine and confined very carefully to the subject of microscopy, omitting the "contributions to biology." No long articles can be accepted. Abstracts, news, and brief articles will be sought. Papers on the subject are scattered widely as is shown by our exchanges. A great number of short items and abstracts of articles will be possible. The price of subscription will be restored to one dollar.

The publication of "The Microscope" will be discontinued with this issue and its subscription list turned over to the American Monthly Microscopical Journal. That magazine will be supplied to all those who have been its subscribers. Those who have taken both periodicals will receive the Journal only unless they by post card or otherwise request a discontinuance. We shall treat all our exchanges in the same way.

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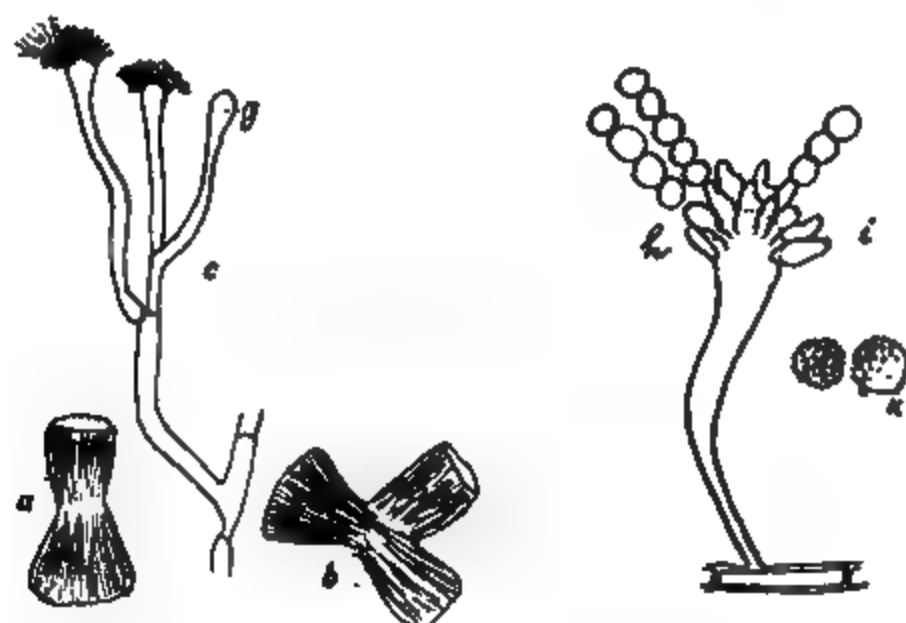
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VOL. XIX. JANUARY, 1898. NO. 1.

Moulds in Medicinal Solutions.

STERIGMATOCYSTIS OCHRACEUS.—This form of mould (figures a, b, c, d, e, f, g) differs from *Aspergillus* slightly. In the latter, the spores are borne on simple flask-shaped bodies, the sterigmata (fig. h) while in the former these sterigmata are compound and branched (d, e). This mould was found in a fruiting condition, but upon artifi-



cial cultivation it developed large, ocher-colored heads of spores. These heads were 80 to 200 microns in diameter, and irregular; the spores were small, spherical, 3 microns in diameter and minutely roughened. This form fluidifies gelatin and changes the color of the medium, but what effect it has upon sugars or the active plant constituents is unknown.

In the cut, a and b are spore heads showing irregular

forms; c is a schematic representation of a fertile branch; d is a primary sterigmata; e is a secondary one; f is a spore and g are columella.

ASPERGILLUS REPENS.—This mould grows much like the *Penicillium* and *Mucor* shown in "The Microscope" for September last. The mycelium is like that of *Penicillium*. The spore head is quite different (h). Primarily the fertile branch of *Aspergillus* is single-celled, non-septate, while those of *Penicillium* are septate. The apex of the fertile branch is swollen, club-like, from which swollen end called columella (12 to 36 microns in diameter) the spores, k, are borne from single, flask-shaped bodies marked d in the cut and called sterigmas. The spores are 6 to 8 microns, slightly roughened, at first yellowish, later greenish to gray. In later cultures small yellowish bodies are found scattered in the superficial mycelium. These are a second sort of fruit-bearing body and contain spores 4 to 6 microns in diameter. They are somewhat lens-shaped and have serrate margins, k. The yellow perithecium is shown at m.

This mould grows scantily upon various media. Upon blood serum it does not grow at all. Milk is made alkaline by it, does not coagulate, becomes thick and stringy and shows the presence of albumoses.

If a solution has developed in it a mould, it is not advisable to filter the solution and return it to stock for the active ingredients have probably undergone some changes. Throw it away.

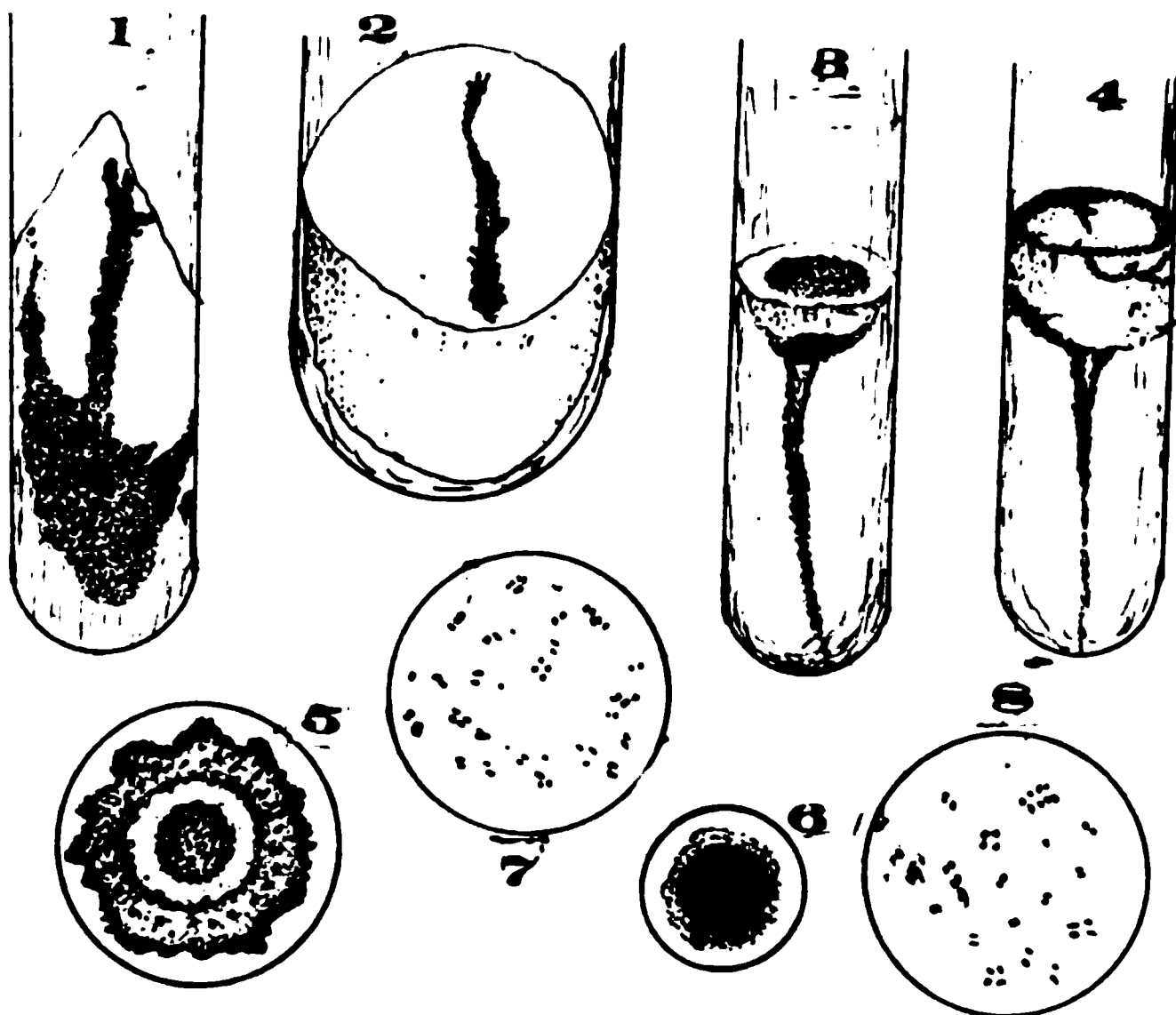
Labrador and Anticosti.—By Rev. V. A. Huard, A. M., Chicoutimi, Quebec. Paper, 8 vo. pp. 505, map and illustrations. Price \$1.70 post paid.

The author of this charming narrative is president of a seminary and editor of a scientific magazine at Chicoutimi in the province of Quebec. The book is in the French language and makes delightful reading for the student.

Bacteria that Curdle Milk.

By R. R. DINWIDDIE.

MICROCOCCUS UBERIS.—This bacterium is found in the milk duct of the cow. The cocci are of medium size, arranged in pairs, irregular groups, or sometimes chains of four to six. They are non-motile and readily stained by aqueous solution. They grow at 20 degrees to 37 degrees C. In agar streak culture, fig. 1, surface growth is free, white and spreading over the surface below while

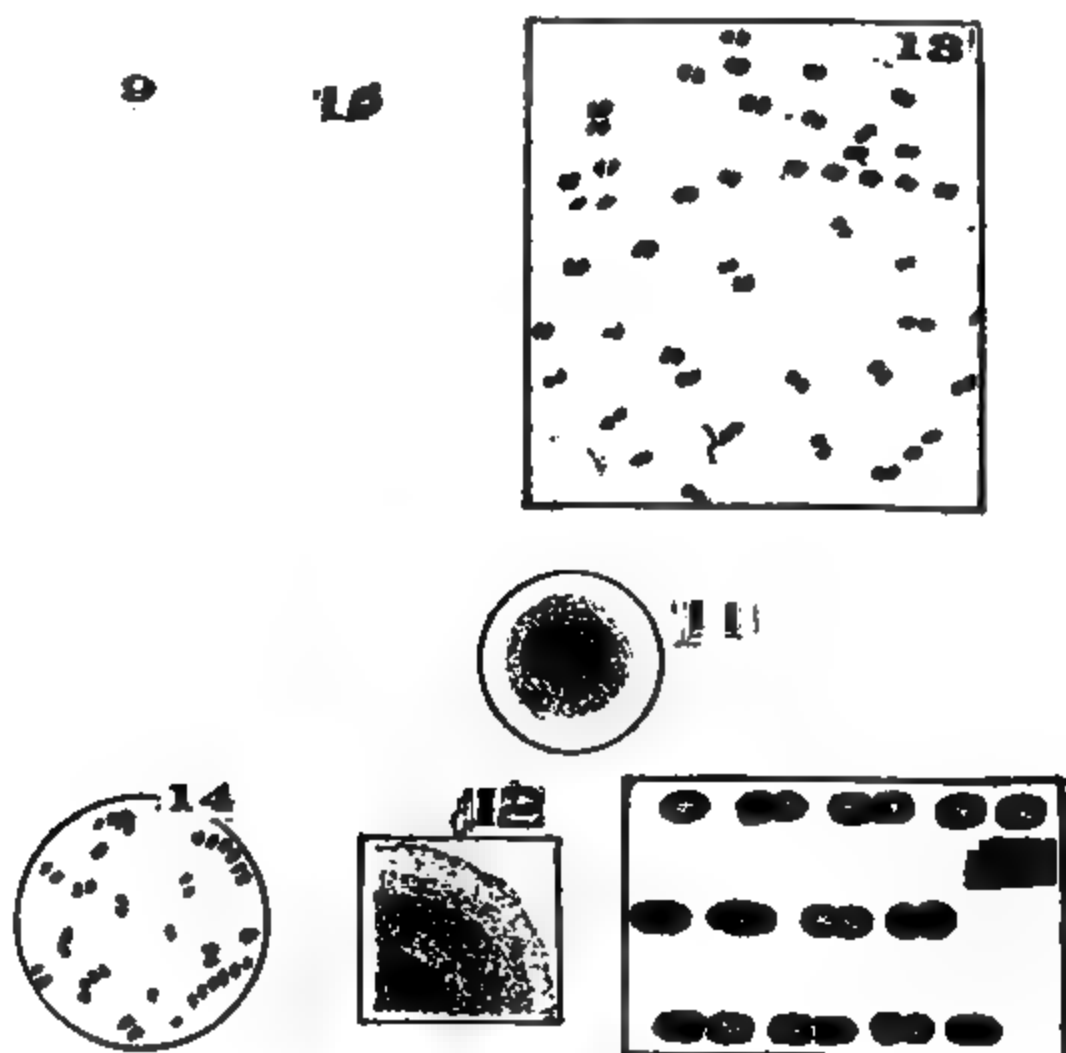


above it is limited to the wire track. Surface, smooth, moist and glistening. Potato culture, fig. 2, at 10 days, shows a free growth limited to the wire track, raised, white, granular.

Gelatin stab cultures appear in fig. 3 (4 days) and fig. 4 (14 days) 22 degrees C. There is early fluidification, a funnel-shaped depression which extends in 10 or 20 days across the tube. In five weeks, half the medium is fluidified.

Gelatin plate surface colony, fig. 5, 3 days, x7, and deep colony, fig. 6, 2 days, x60, both are 22 degrees C. In 24 hours the colonies appear as white points. If x60 they appear greenish yellow. In 5 days, they become 2 to 4 mm in size with a central area and a peripheral zone.

Figures 7 and 8 show cover-glass preparations from bouillon culture, one x600 and the other x1500, taken



with Reichert's ocular 4, objective 1-18. At 20 degrees C., the milk sours and curdles after 4-5 days; at 37 degrees, there is free growth but no curdling.

BACTERIUM LACTARII.—This is found constantly in milk that has soured spontaneously. It is oval, single or in pairs. Chains of 4 to 6 each occur. Fig. 13 shows pairs, with the attached ends square and rounded. Segments-

tion occurs at length of $2\frac{1}{2}$ microns.. Stain by Gram's method and by the hydro-alcoholic solutions.

Fig. 9 shows agar streak culture, 2 days. It is first visible in 24-48 hours as a faint granulation along the inoculating line. Magnifying, small colonies are made out and are colorless. A yellowish white sediment appears in 24 hours. On glucose-agar the growth is larger. In lactose-litmus agar, the colonies appear all through the medium, pink color from surface to bottom.

Lactose-gelatin with chalk (fig. 10) at three weeks shows larger, opaque colonies, circular and regular in outline. Diameter half a millimeter.

Gelatin plate colonies: deep, 3 days, and surface, 4 days, are shown in figures 11 and 12 enlarged 100 dia. They are quite circular with regular and well-defined margin. Diameter, .25 mm. On potato, there is no growth.

Cover-glass preparations, x1500, are shown in figures 13 and 14, the former a 3-days milk culture and the other a 2-days glucose-bouillon culture. Figure 15 shows growth and segmentation.

The milk forms firm coherent clots in 20-30 hours ordinarily, but in incubator in 12 hours. It is strongly acid with faint sour odor.

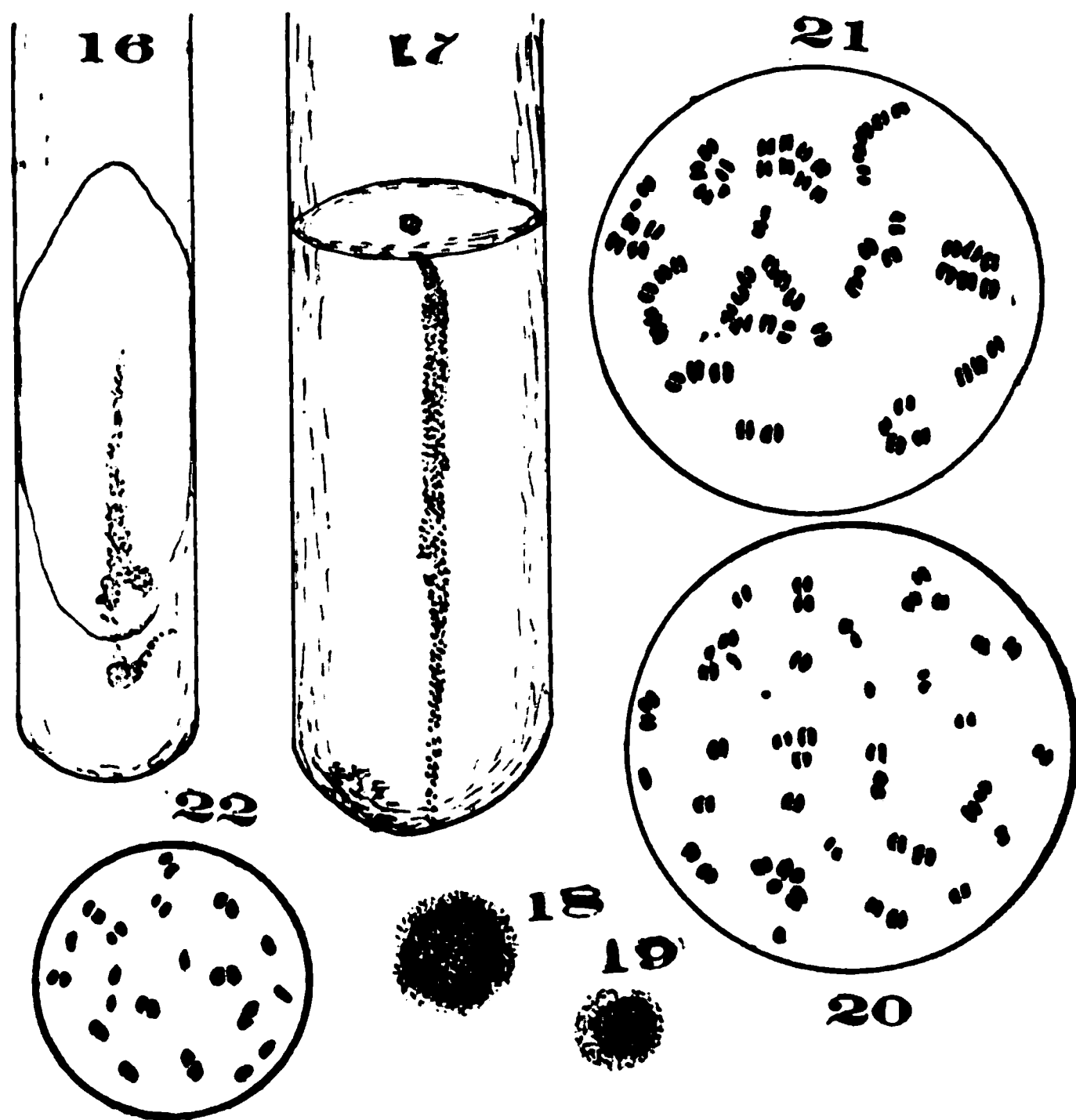
BACTERIUM DISCISSUM occurs in spontaneously soured milk. They are oval, in pairs, in chains or singly. Single forms are half longer than broad—dimensions 1.5 microns by 1 micron. In glucose bouillon, the chains are most abundant and larger than elsewhere. The individual elements of the chains are nearly round, segmented and vary in size as shown in figure 20.

Glucose-agar streak culture of 10 days growth shows as in figure 16. In glucose bouillon the turbidity appears later but is equally dense.

Gelatin tube stab culture of 5 days standing, fig. 17;

gelatin plate deep colony, 6 days, fig. 18, is magnified 100 dia.; gelatin plate surface colony, 5 days, figure 19 is magnified 60 diameters. Cover-glass preparations are shown in figures 20, 21, 22,—milk culture, x1500, in fig. 20; glucose bouillon culture, x1500, in fig. 21; and agar culture, x1500 in fig. 22.

The cultural characters are in nearly every way simi-



lar to those of *B. lacterii*, but in agar tube the growth is feeble, in gelatin plate the ringed appearance is fainter and the quantity of clear fluid separated from the curd is larger especially at temperature of 37 degrees C.

Those interested in fuller details of this milk problem should send to the Arkansas Agricultural Experiment Station for Bull. No. 45 which is distributed gratuitously.

Gates' Double Microscope.

Apparently Professor Elmer Gates of Washington has made one of the most important discoveries ever achieved by science—that a second microscope can be used to view and magnify again a small part of the image produced by a first microscope. Thus the power of the human eye is increased 3,000,000 times instead of 10,000 times, as hitherto, for though the human eye cannot, of course, see the image directly it can see a reproduction of the image and thus microscopy is carried as far beyond the present art as it is itself beyond the power of the eye. His process is as follows :

“On the Abbe plate, consisting of fine lines ruled close together, a $\frac{1}{2}$ -inch objective showed four lines and three spaces. With a 1-6-inch it showed nine lines and eight spaces. Then, taking a second, with a 2-3-inch objective, or a 14 mm objective, it was focused upon the real image of the microscope by introducing the ocular of the first microscope, so that the plane of the second objective was in the plane of the real image, and then two lines and one space covered the entire field of vision.

This is only, however, the first step. When I replace the 2-3 objective of the second microscope the magnification is 400 more diameters, but the image cannot be seen by the eye. It must be photographed. With a one-twelfth objective on the first microscope and a three-inch on the second I get a magnification of 3,000,000.”

He is delighted with this discovery because he wishes to study the constitutional units of the cell as modified by the mental activities of that cell. A great difficulty arises in the focusing of the projected image of the second instrument upon the sensitive plate because beyond 360,000 diameters the eye cannot see the image. A series of empirical approximations are used to find the focus. He hopes yet to be able to photograph ten times

as many diameters. He further explains his work thus :

I use the best known form of microscope and prepare the slides and slicings and stainings in the usual way ; and focus and illuminate so as to get the clearest and highest magnification of the object, when viewed through the usual ocular. Then I remove the outer lens of the ocular. It can be shown that the "virtual" image produced by the ocular and eye, although it looks much larger than the "real" image, adds no new details to the real image. This fact is known to many modern microscopists. I therefore use the "real" image as the starting point for my new microscope.

I bring down upon this "real" image or "focal plane" the objective of my second microscope, and thus magnify the "real" image so to exhibit in it details which cannot be seen when this real image is viewed through the ocular of the first microscope.

This is due not only to the special powers of the second microscope, but to an advantage which I have taken of a unique fact in photography, namely, that when two lines, markings or colors in an image are too close together, the sensitive plate will not record them as two but as one. Thus, when I ruled two lines upon a metal plate too closely together, the image of these lines thrown by a camera upon a sensitive plate would irradiate in the film and the picture would show only one line. The line of light falling on the photo-salt in the film spreads by molecular irradiation over more area than the actual width of the line of light, and there is also diffused reflection of this line of light by the semi-transparent substance of the film. To these two causes is due the fact that when the details of two structures are too close together in an image of an object, these structures will photograph as one, and thus the detail will be lost. The line of demarcation between them will, in the film of the sensitive plate, be obliterated by the irradiated and dif-

fused light. This is why all details below a certain size are lost in a photomicrograph. The space between two points that are too close together on a film is acted on by the light irradiated by these points. The "two points" are separated by magnification to such a distance that when the photograph is made the irradiation will not cover the space between the points.

The first microscope takes the light from a very small object and spreads it over an area of sensitive plate one hundred million times as great as the area of the object from which it comes, hence the light has only the 1-100,000,000 as great an intensity as when it started from the object. The light is already too weak to photograph with if best results are desired. But select some small area of this faint image and subject it to a still further magnification of six hundred additional diameters. This light becomes only the 1-360,000 as strong as it was, and the natural eye cannot see the second magnification because the light is too weak. But by remaining several hours in a completely darkened room the eye can see very faintly such magnification. But when a sensitive plate, is put in place of the eye it acts cumulatively, and the faint light rays which the eye cannot clearly see will fall hour by hour upon the plate and slowly accumulate enough effect to make a visible picture. The structural lines which in the image of the first microscope are too near together to be photographed as distinct objects, are in the image of the second microscope 600 times farther apart and do not blend by diffusion and irradiation.

It is not very difficult to distinguish on a good photomicrograph, made by best modern methods, lines which in the original object are not more than the one-tenthousandth of a millimeter apart, but much beyond this the microscope and photo-micrography refuse to go, because the images of these lines on the sensitive plate

affects the photo-salts in the space between the two lines and this is done by diffusion and irradiation.

We are promised some criticisms of Gates' methods for February and desire others.

Amoeba in Winter.

By W. E. DEEKS, M. D.

During the summer they can be obtained by scraping the under surface of a floating weed or in the superficial ooze along the bottom of any fresh-water pond. In winter we need aquaria, and of these a certain amount of care is necessary to keep the forms in a living condition. The most suitable temperature for them is between 45 and 70 degrees F.—a sufficiently low temperature which will also prevent the bacteria of putrefaction from developing too rapidly. Along with them are usually found the Heliozoa, the stalked Ciliata and some of the Flagellata. If the temperature is raised to about 80 degrees F., they quickly disappear and in their place countless numbers of the free-swimming Ciliata make their appearance. The water also becomes putrid.

In the Autumn the superficial ooze from some fresh water pond is skimmed and placed in a dish, the mouth of which is covered almost completely to prevent too rapid evaporation. Along with the ooze get some decaying vegetable matter and also some living water plants—Anacharis, Chara and some other common forms will do. A considerable quantity is necessary to keep the water fresh. The aquarium is then placed in a place where there is plenty of light (though preferably not direct sunlight), and in a cool place, best about 60 degrees F. This then can be left any length of time, and when they are required, by squeezing a little of the decaying vegetable matter on a glass slide, I have never failed to find one or more.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON,

CLEVELAND, OHIO.

MICROMETRY.—"While all the principles of micrometry are simple, it is very difficult to get the exact size of microscopic objects. This is due to the lack of perfection and uniformity of micrometers, and the difficulty in determining the exact limits of the object to be measured. Hence, microscopic measurements are only approximately correct, the error lessening with the increasing perfection of the apparatus and the skill of the observer. It is said that 0.2 of a micron is the limit of precision in microscopic measures, beyond which it is impossible to go with certainty."—Gage.

GROUND-GLASS SLIDE.—In using the dissecting microscope with a mirror there is generally too much glare. This can be obviated if we intercept the light by using a ground-glass slide on the stage. The light will then be diffused and work may be accomplished with comfort.

PODOSPHAERA BIUNCINATA.—This is one of the fungus species of the family Erysiphæ. The beautiful and interesting plants of this family have now ripened and the autumn leaves are full of them. They are readily gathered and easily manipulated. All that is necessary is to scrape off a few of the little dots, place them on a slide with water, cover, then see that the space under the cover is filled with water. Examine with a power of an inch, and if desirable, afterwards use a power equal to a quarter. Remove the dots carefully from the leaf and be careful not to roll the specimen up with the spider-web-like mycelium. The round dots are the perithecia which contain the asci with spores. To see the latter, press on the cover glass and gently split the asci. No reagent of any kind should be used. *Podosphæra biuncinata* is a striking species. The peritheciæ contain but a single ascus

and have six to twelve appendages, three to five times as long as the diameter of the perithecium. Each appendage is tipped with a conspicuous fork. These tips somewhat resemble uncinula but in uncinula the tips are hooks and shepherds' crooks and in biuncinata the tips are forks which are not hooked.

AMŒBAS.—A large supply of these very interesting animals may generally be obtained from the ooze on the bottom of public fountains. When the water is allowed to escape preparatory to cleaning the fountain, an opportunity will be afforded for collecting this ooze. When collected, leave the mouth of the vessel containing the animals open, as all terrestrial life requires air.

EDITORIAL.

Subscription Price.—It will be one dollar for 1898 if paid directly to the publisher in advance or during the present month. We authorize no agents. Those who wait, or pay through self-appointed agents, bookstores, etc. should pay two dollars out of which the intermediaries may take their pay.

The X Rays.—At the inauguration of the Roentgen Society in London, the entire skeleton of a living woman was exhibited life-size.

Agar-Agar.—A nice method of preparing nutrient agar-agar for bacteriological work has been published by Dr. H. B. Sheffield in the Registered Pharmacist for November. He pronounces it "simple" but the process is at best very tiresome. We will not copy it unless requested so to do but be content with this reference.

For Sale.—A Crouch instrument with two objectives is for sale cheap by "Alpha," Wadham House, Wentworth street, London, England.

Silk Adulterations.—It is found that in London only about 28 per cent of certain silks is silk. The adultera-

tion is with tin. It is in the "weighting" of the silk. This silk stands only three months steady wear.

Effectiveness of the Microscope.—The angular aperture of objectives has been increased about all that it is likely to be. We shall hereafter look more to the utilization of shorter wave-lengths of the invisible ultra-violet rays for improvements in magnification and resolving power than to angular aperture.

Enlarging photographs does not help us for there is nothing of detail in the enlargement that was not in the original. If new details are to appear, they must be secured by enlarging the image before it is photographed. That is what Gates claims to have succeeded in doing.

H. S. JEWETT, M. D.
DAYTON, OHIO.

Microtome Work Outdone.—The limit of thinness cut by the microtome has been about 2-1000 of a millimeter. No one has ever thought of slicing up a blood-cell except Elmer Gates. He also sections microbes. Cement on a glass slide a single layer of cells. Then cement another glass slide to that. Cut the two apart with a very thin blade of copper the edge of which has first been sharpened to the finest degree possible. Copper being finer grained than steel takes an edge that razors are incapable of receiving. Use adamantine paper upon a glass surface as a whetstone. A still finer edge is got by polishing it with a piece of soft wood. Get the edge exactly in the middle between the two surfaces on the copper plate.

The cells having been once sliced are again cemented to glass and cut open once more. Gates has made slices 1-100th the thickness of the thinnest ever made with microtomes.

Yellow-Fever Prize.—Brazil offers \$200,000 for a demonstration of the bacillus of yellow fever, the surest and easiest means of its recognition, and an effective means of treatment. It purposes to build a laboratory for preparing curative serum as soon as that serum is discovered.

Bromine Sterilization.—To each litre of water add .06 gram of bromine, then in 5 minutes ammonia to neutral-

ize the bromine. Schumberg says use a solution made of 20 grams bromine with 20 grams bromide of potassium dissolved in 100 grains water. Use this solution in the proportion of 2 cc. to each litre, stir, let stand 5 minutes. Add 9 per cent ammonia water to neutralize. The taste of the water is not affected by this small amount of bromine salt.

SCIENCE-GOSSIP.

Amoeba Coli.—Amœba have been found in the human intestines associated with a special form of dysentery and with abscess of the liver. It is believed that they gain entrance to the system by means of the water drank and the uncooked vegetables eaten. In the trip from the intestines to the liver, it is supposed that they pass through the vessels that drain into the portal vein.

These Amœba have been found in people who are not suffering from dysentery. It is quite conceivable that they may enter the deeper layers of the mucosa and so into the blood streams. The analogy of the white corpuscles escaping by diapedesis through the blood-vessel wall is very interesting. That they are found in healthy intestines is no stranger than that the Klebs-Loeffler bacillus of diphtheria should be found in the mouths of healthy people. A lowered vitality is necessary before these organisms can work injury.

A case of dysentery and liver-abscess is reported in "The Lancet" for Dec. 11, 1897, of a Lascar, 19 years old, in which 22 oz. of pus were aspirated from the right pleura. On microscopic examination, pus cells, red and white blood corpuscles, degenerate liver cells but no amœba were found. Later when a liver-abscess was opened they were found actively moving in the liver pus till two days after the operation. Three weeks later the patient died from exhaustion. Amœba were also found in the lining membrane of the main abscess and in the pus from the three patches of softening in the liver.

Bovine Tuberculosis.—Some of the cows at the Kansas Agricultural College were suspected of tuberculosis. At length some of the cattle tenders were taken ill. One died. Then a cow was killed and examined. Its lungs were found to be "a mass of tubercles," the pulmonary and costal pluræ were covered with tubercles and the entire entrails were diseased. The result from a tuberculin test was that the entire herd of 58 cows was believed to have become infected. "Probably the sheep and hogs also are infected" reported the investigating committee.

We should remember that one-seventh of all deaths are from tuberculosis and that cows are a prominent medium of communicating it. In Massachusetts, a report on 3000 cattle, reported 18 per cent to be tuberculous. In North Carolina 50 to 70 per cent were found infected. As many as 50 per cent have at times been found to have tuberculosis of the udder.

Slaughter Houses Breed Disease.—An official inspection of these establishments in this country shows that many bacterial diseases are propagated therein. If one hog has trichinosis, the offal from its slaughter fed to other hogs will and does surely infect the rest with trichinæ. Rats are also present. They feed on the same offal and are infected. The dogs and cats that eat them become infected. Hog cholera, swine plague, wire-worm, staggers and other echinococcus diseases, parasites, etc., are multiplied in America faster than elsewhere because of the lack of care and cleanliness resultant upon our haste to get rich.

The Metal-gnawing Beetle.—In 1888, an individual specimen was brought to New York from Mexico and later others have been seen. They are 1 1-2 inches long and somewhat mottled. They can cut their way out of wooden or pewter receptacles if there be an exposed edge. They do not bore. Mr. F. W. Devoe of Fulton st. has reported before the N. Y. Micro. Society, the experiments made by him. His beetle by aid of its mandibles cut away the pewter between two holes and united them in one as an

avenue of escape. The bits were not swallowed but dropped in the jar and are now in evidence. The mandibles must be harder than the metal in order to cut it.

This beetle is called *Zopherus Americanus*. It has not been known to cut iron or steel.

Live Specimens.—*Amœba*, *Arcella*, *Actinosphærium*, *Desmids*, *Diatoms*, *Floscularia*, *Hydra*, *Melicerta*, *Spirogyra*, *Stentor*, *Volvox*, *Vorticella* and many others can be got at 25 cents per tube postpaid from Thomas Bolton, 25 Balsall Heath, Birmingham, England.

RECENT PUBLICATIONS.

Petrology for Students.—This is the title of Alfred Harker's little guide to the study of rocks in thin sections. A second edition has recently come from the Cambridge University Press. Increased attention has been given to the American igneous rocks.

Mammals, Birds, Fishes.—New book by Dr. R. W. Shufeldt, 400 pages, 130 nice illustrations, popular but scientific. \$3.50. Studer Bros., New York City.

FOR SALE—DIATOMACEARUM SPECIES TYPICÆ

Hamilton L. Smith.

Seven hundred slides of typical species of Diatoms, in 28 rack boxes, book form, the boxes 6 5-8 x 4 1-8 x 1 3-8 inches. Printed labels on each slide, and names on bottom of boxes inside, under each slide, and a list of the slides on a card in each box. Good as new. Cost \$140 will sell for \$50. Also

Monthly Microscopical Journal, containing Trans. Royal Micros. Society, 1869-'77, 9 years, bound, 18 volumes; Jour. Royal Micros. Society, 1878-'94, 17 years, bound, 28 volumes. In all 46 vols. in good order. Price \$46.

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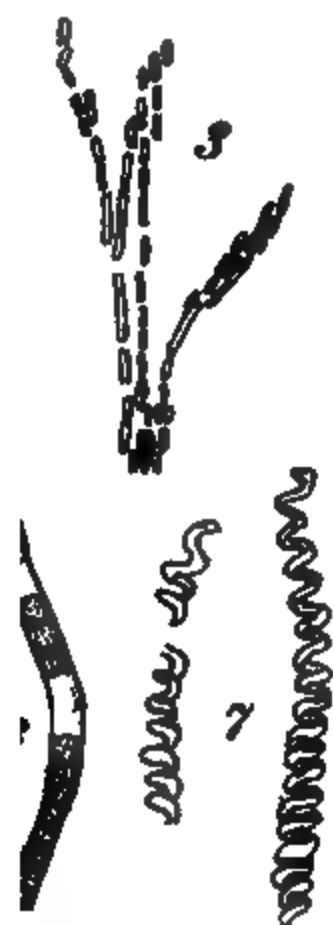
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Microscopic Forms at Yellowstone Park.

THE BACTERIA OF THE HOT POOLS.—At the hottest pools may be found filamentous growth of pearly luster, white or gray scattered along the edges of the little streams or forming a delicate net work at the bottom. These tufts shown in fig. 1, may be six inches long, and the water is never below 85° C (185 F.).

BEGGIATOX.—Figure 2 shows these filaments under low powers, a quite homogeneous strand, stiff, stringy, gelatinous and coated with minute crystals. Carbon bi-sulphide dissolves them which proves the deposit to be sulphur. Stain and put under an immersion lens of 1,000 diameters. Then innumerable rod-like forms of bacteria appear imbedded in the gelatinous matrix. All these chains vary in length the larger breaking up into the

smaller (fig. 3, x 2,000 dia.). The long axes are parallel with each other and there are many hundreds of these bacterial lines placed side by side in a single filament which may be called an elongated zoogloea coated with sulphur particles. Do they attract this coating? Such is the case with the genus *Beggiatoa* which leads to a belief that this is a genus of that species. Some of the



Beggiatoa even engulf grains of sulphur within their infinitesimal cell-walls. Figure 4 with magnification of 500 diameters is known to be a *Beggiatoa* but fig. 3 when x 2,000 does not give any such detail for the sulphur grains are plainly shown in figure 4. The rod shape proves a bacillus. The attraction for sulphur proves a *Beggiatoa*.

These filaments are coated so beautifully with calcium carbonate and sulphur as to appear like icicles in the

scalding water. The threads are cemented together by the lime.

PHORMIDIUM.—Another formation in the bottom and sides of these hot pools is of a leathery, felty appearance and shows many crystals of calcium carbonate (fig. 10, x 250 dia.). These filaments are less than 1-1,000th of a millimeter in diameter and are glued together. The surface is smooth and slippery but gritty because of the crystals of calcium carbonate. The cells of this organism,



magnified appear elongated and of a greenish color. It is *Phormidium* and akin to *Oscillatoria*—a very common blue-green alga of stagnant water. The several species of the Yellowstone are distinguished by the size of the cells. The smallest, fig. 5, grow in water hot as 75° C. The larger, fig. 6, are found in water not so hot. The tint is at first bright green but later is brownish. Mineral deposits produce golden yellow color and dark red. The sun will bleach them all white.

SPIRULINA.—Figure 7 shows another form, so-called

from its spiral coils. It has a power of movement. The free ends can swing from side to side. This and the previous form often mingle to make artistic rims raised above the hot water pools. They may be seen at Prismatic Spring in Middle Geyser Basin. In the margins of this spring, 300 feet wide, dark-blue at center, are beautiful shades of green to light yellow. Over the rim splashes the hot water. The wet algæ are too hot for one to hold them and one need not venture too near it.

ANABŒNA.—In the cooler places we begin to discover diatoms and a specie of Anabœua, one of the family of Chlorophyceæ.

GLÆOCAPSA.—This is a unicellular alga, figure 9, having very thick cell walls made up of an outer gelatinous layer and others concentric in arrangement. These slimy filaments are constantly damp from the condensation of steam that arises and meets them. The students of algæ find rich harvests of Schizophytes and Cyanophytes at these hot springs.

Some Photo-Micrography Experiments.

By A. WOOLSEY BLACKLOCK, M. D.

I use a hand-camera for this purpose. Fair results can be got by adjusting the lens to its solar focus or for distant objects. Recent experiments as follows have improved the results:

I focussed an object carefully with the eye in the usual way, placed a camera with its objective close to the eye-lens of the microscope, and shifted the ground-glass until I secured a thoroughly sharp image of the object on it. I then removed the camera, without changing the relative positions of the objective and ground-glass, and having made a few fine scratches through the film of a spoiled negative, I placed this in front of the objective of the camera, and moved it about until the scratches were

sharply defined on the ground-glass. I found that this was at a distance of 8 in. from the lens, and concluded that this is the distance of the virtual image which I see when I use the microscope. I then substituted a fresh object on the stage of the microscope, carefully focussed it, replaced the camera without focussing it, inserted a sensitive plate, exposed, and developed it, getting a very much better image than hitherto, really sharp, with a power of 55 diameters. I next attempted a very difficult object, *Pleurosigma angulatum*, the objective being a Beck $\frac{1}{4}$ in., and the eyepiece a $\frac{1}{2}$ in. Huyghenian belonging to the telescope. This was carefully focussed, and the camera reapplied, with the result that the negative shows the diatom dotted all over the field. Those who know the difficulty of seeing the dots in this object will understand the severity of this test. The lens of the camera was a plano-convex achromatic objective from an opera-glass, $4\frac{1}{2}$ in. focus, the distance of the objective from the plate being about $10\frac{1}{2}$ in. Shortly afterwards I substituted a stage micrometer for the diatom slide, and found that the actual magnifying power was 1,000 diameters.

Methods in Microscopical Technique.

I. Down to recent times the microscope was utilized by means of various optical accessories and their development was a matter of physics. Methods of manipulation then in vogue have since largely fallen into disuse and their votaries have become less in number. Mr. H. B. Ward cites as an evidence of the failure of that line of development the fact that diatomists cannot agree regarding the interpretation to be put upon a direct image presented by the microscope. The followers of this school took their objects for study as they found them in nature and without preparation of any sort.

II. The next method came into vogue when the physicians, botanists and biologists began to utilize the instrument for their purposes. Mounting after killing, hardening, fixing, sectioning, and staining, led to satisfactory results. Biology made rapid progress. Every month brings refinements and additions to these operations. The optical accessories are largely replaced by these mechanical and chemical aids. Mineralogy has also resorted to sectioning. Hundreds of workers by this method have replaced the tens who "fought objectives" on optical grounds. Microscopy has thus become subservient to the sciences and is not and never will (again?) be a science of itself.

III. There are those who are not satisfied with the foregoing. Prof. H. B. Ward is one of these. He says:

"The methods in vogue today for the examination and study of living substance are but little improved over those which obtained some thirty years ago; if possibly we can see a little more it is because we have better lenses and better instruments. The cell as a living thing, as regards the changes which take place during its processes, is known by inference from the dead object rather than by observations upon its living substance. It is a chemical laboratory and should be studied that we may know the reactions which are taking place in it. If the methods of microscopical technique most generally in vogue at the present have given us, as it were, a series of instantaneous photographs of the cell and of the arrangement or rearrangement of its various parts in various conditions, there yet remains to be developed that technique which shall show us these substances in the process of synthesis and analysis, that the investigator may be able to follow the workings of the cell as a formative power and see how living matter operates." Perhaps Professor Gates has already supplied what Professor Ward calls for. We shall soon see.

Dahlia as a Stain for Bacteria in Sections Cut by the Collodion Method.

Probably the greatest difficulties have been found in the staining of the imbedding medium or in the albumen fixative. They usually obscure both the tissue elements and the bacteria. Unless the sections are cut in paraffin and not fastened to the slide by these common fixatives the bacteria are not brought out. With loose or fragile tissues there is great danger of tearing or of losing parts of them during staining and dehydrating. Although paraffin is commonly used, collodion is more often employed. The rule in normal histology is to fasten the sections to the slide. In pathological histology, they are not, for the reasons mentioned, ordinarily fastened. The need of having an absolutely perfect section from a pathological tissue, especially for diagnosis, is even greater than is the case when sections of normal tissues are being made. The loss of a very small bit from the section may cause an entirely erroneous interpretation. By the use of collodion as the imbedding medium this danger is eliminated. The method is simpler and the sections are fastened to the slide by collodion or an albumen fixative.

Collodion takes most of the aniline dyes and gives up the stain only when treated with a decolorizing agent sufficiently strong to decolorize the tissue at the same time. In the case of paraffin sections which have been fastened to the slide with collodion or albumen fixative, or both, besides the disadvantage of using a process which takes a longer time, we meet the same difficulty that we did in the collodion method. The fixative takes the stain and obscures the preparation quite as much as does the imbedding collodion.

Both the collodion and the paraffin methods have advantages. In pathological histology I prefer collodion to paraffin. The whole process of sectioning by the oil-col-

lodian method has been described heretofore. The sections are fastened to the slide by putting a few drops of ether and alcohol on the section after it is in position. Use a mixture of three parts of xylene and one part of castor oil as a clarifier. In passing a section from water to strong alcohol, or vice versa, avoid the diffusion currents by plunging the slide directly into the desired liquid instead of carrying it through successively higher or lower percentages of alcohol.

We want a suitable dye that will stain the bacteria properly and yet one that will wash out of the imbedding material without the use of a decolorizing agent so strong that it will remove the stain from the tissue and the bacteria. Having some sections that I wanted to stain with gentian violet, but being out of it, I substituted dahlia. These sections had been cut by the paraffin method and the stain not only showed the bacteria well but brought out the histological structure of the tissue. Later, I cut some sections from material which had been imbedded in collodion and stained them for bacteria. After trying carbol fuchsin and methyl violet, I tried an aqueous solution of the dahlia. It worked perfectly. In the process of washing and dehydrating this was entirely removed from the collodion, leaving both the tissues and the bacteria well stained and sharply differentiated.

Other formulæ, using dahlia as the dye, were unsatisfactory, such as a solution containing less of the elements of a mordant nature, using 2 per cent. carbolic acid instead of 5 per cent., which did fairly well and also Koch-Ehrlich's aniline water solution which stained the collodion too deeply. The formula for the stain used is: Saturated alcoholic solution of dahlia 20 c c; distilled water 100 c c. The length of time varies, according to the condition of the tissue, from fifteen minutes to half an hour. They must be distinctly overstained. Wash thor-

oughly with 95 per cent. alcohol until the collodion around the section appears colorless, and clear with a clearing fluid, preferably clove oil. The tissue will be well defined and the bacteria will stand out deeply stained against the more lightly stained cells of the tissue.—From R. C. Reed's paper read at Toledo, 1897.

Gates' Double Microscope.

A writer in the English Mechanic claims to have seen, years ago, the effects reported by Mr. Gage and to have proved them all illusions. He says that setting up two microscopes as claimed results in enormously increasing the spherical and chromatic aberation and in the production of false images. The two objectives are never aplanatic and usually uncorrected. Then diffraction may cause apparent detail to appear in an image which is not actually in the object. It is therefore believed that Gates has been deceived by this scheme.

It is said that Gates shows ignorance of fundamental principles when he speaks of "a lens of small aperture like a 1-16th" not equaling a 1-6th for his purpose as if the amount of light utilized by any objective depended simply on the size of the opening as is the case with telescopes. That the cone of light admitted by the objective has an influence does not appear to have been considered by him.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON,

CLEVELAND, OHIO.

PTLIDIUM CILIARE.—The name of this beautiful specimen sometimes gets printed as Palladium ciliare. The spelling is peculiar and emphasizes the fact that scientific names should be plainly written. Much blame upon the

printers and annoyance to authors would thereby be avoided.

BONES.—The Luetgert trial suggests to our workers to investigate and if possible discover what, if any, histological differences exist between human and animal bones. The analogous bones should be compared. Thin sections of the bones should be examined. Bones are comparatively soft and sections may be rapidly made. A measurement of the average sizes of lacunæ, canaliculi and of the concentric lamellæ around the Haversian canals might be productive of good results.

CARTILAGE.—Sections of different kinds of cartilage make interesting slides. There are numerous points to be studied. For instance hyaline cartilage, costal cartilage, the capsule, the lacunæ, fibro-cartilage, yellow or elastic cartilage.

FATS.—Nearly all fats contain crystals that will polarize beautifully. Most fats are true salts composed of an organic or fat acid united to a base. To see these crystals, place a minute piece on a slide and cover, press on the cover and spread out to a thin film.

After the first examination, heat the covered slide enough to melt the enclosed fat. After it cools, the crystals will form and rearrange themselves. A knowledge of these crystals is useful in the detection of adulterations.

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Slides.—W. White, 2 Rick street, Nottingham, England, offers cabinet of 72 slides for 21 shillings.

EDITORIAL.

American Microscopical Society.—We have been favored with a “stop my paper” from an official of this society who says it is because of the course we have pursued. Let it be distinctly stated that we have done nothing to injure the society. We have done and will do all in our power to benefit it. All of our criticisms have been addressed to those persons who by neglect or folly have injured the society. We will do anything that anyone will suggest which promises to benefit the society, even to keeping silent.

Trying to find out the causes of the Toledo dearth (only a dozen members went there), we wrote to Dr. Manton, a member of the executive committee asking his view of the cause. In his reply he says: “Shortly before the meeting, I picked up my copy of the 1896 Proceedings and noticed that my name was on the executive committee. This was the first knowledge which I had of my appointment. Neither the Secretary of the society nor the chairman of the committee took the trouble to notify me of the fact and there was no correspondence, so far as I am concerned, regarding the arrangements for the meeting.”

He then explains that his duties called him elsewhere and are likely to do so. He makes the following excellent remarks: “I should say decidedly that the society should not be allowed to die. There should be a sufficient number of college professors and teachers of science interested to maintain it. It is this class of members who have the time in summer to attend and their line of work should furnish them with material for papers. If the society is properly managed, there need be no lack of interest or a paucity in attendance at the meetings.”

It is now time that the place and date for the 1898 meeting were known and that pledges were secured from members to present papers, working exhibits, etc. We will report all preparations made so far as we can learn of any. We shall also continue to direct attention to the subject.

We understand from Dr. Krauss that the 1897 Proceed-

ings are all in type and we hope they will be published by February.

Moulds.—Dr. Smith Ely Jelliffe of Brooklyn has been carrying on some excellent investigations. We presented an article last month which we abbreviated from the “*Druggists Circular*”, one of our best exchanges and in which there is often something of interest to microscopists.

Periodical Sale.—With only one insertion of the “*M. J.*” advertisement, the owner has sold to one of our esteemed contributors the 46 bound volumes of the *Monthly Microscopical Journal* and the *Royal Microscopical Society Journal* for \$46, cash on delivery. It is a bargain and another such opportunity may not occur in many months.

Catalogue.—Send 2-cent postal card to Dulau & Co., 37 Soho Square, London, for 30-page catalogue of books and papers relating to microscopy and for sale by them at net prices named in this pamphlet. Some of the prices are very high but they have a really wonderful collection of microscopical publications.

Objects.—Suter, 10 Highweek road, Tottenham, London, sends free a catalogue of 50,000 choice objects. He buys collections and sells cabinets.

Most Powerful Objective.—The best yet made is the 1-10 inch mono-bromide of naphthaline immersion lens, numerical aperture of 1.60 made by Zeiss. Its work is limited to resolving a detail more than 1-8000 of a millimeter (.000,005 of an inch) in width.

Leprosy.—The International Congress on Leprosy has declared that this disease is due to a bacillus discovered by Hansen in 1871, that no other animal than man suffers from it, that it is contagious but not hereditary, and that isolation is desirable.

Vaccination.—Small granular ameboid bodies are found in the blood of vaccinated children. Similar amœba have been found in blood of vaccinated monkeys. They have a diameter of one-third that of a red blood-cell.

Leuwenhoeck.—Two volumes of his works, bound in half morocco, nice and perfect for sale at \$15.00.—C. W. S.

SCIENCE-GOSSIP.

Chlorosis and anæmia.—Dr. Klots having treated these diseases with nucleo-albumins and bone-marrow, photographed the blood before and after with remarkable results. In four weeks the hæmoglobin increased as shown by the following per cents: 54, 57, 64, 70, 74. The increase in weight of the body was from 117 to 119, 121, 123, 124 pounds. The number of red blood cells (in millions) was 2.7, 3.0, 3.6, 4.0, 4.1,—an increase of over 50 per cent.

Carcinoma.—Dr. Palmer Findley of Chicago, says that diagnosis of cancer of the cervix is often impossible without the aid of the microscope. To await development is hazardous. If doubt exists a microscopic examination of a piece is imperative. If pieces cannot be cut, resort to scraping. Practical knowledge of microscopy is essential. This may indicate or avert hysterectomy according as there is a malignant growth or merely an inflammatory lesion. Embed the cuttings in celloidin preparatory to mounting.

Celloidin Embedding.—Cleanse the tissues in cold water. Keep in 4 per cent formalin 12 hours, in 50 per cent alcohol 24 h., in 70 per cent alcohol 24 h., in 95 per cent 24 h., in absolute alcohol 24 h. If small, that process may be shortened, the object being merely to harden them. Then put in dilute celloidin 24 h., in thick celloidin solution 24 h., mount on cork for cutting. After exposure to open air for a few minutes, immerse in 70 per cent alcohol for a few hours, then cut. Double stain the sections with eosin and hematoxylin. For serial sections the paraffin method must be used, but then an oven kept at a proper temperature is a troublesome necessity.

Freezing.—Animal tissues may be cut in 50–60 minutes if frozen but such preparations are never so satisfactory as those made with celloidin or paraffin. After cutting

with freezing microtome, fix sections in 4 per cent formalin sol. 3-5 minutes, absolute alcohol 1 minute. Stain and mount.

Redondo Beach Diatoms.—In a bluff on the beach 10-25 miles south of Santa Monica, Cal., exists one of the finest deposits yet known. The foot of the cliff is accessible only at low tide, when pieces broken off by the waves can be picked up. Tidal refuse has been carried as far as Santa Monica where the diatoms were first found in 1878. This material contains a great variety of diatoms which are listed in Bull. Torrey Bot. Club, Nov. 1897, by E. A. Schultze and C.H. Kain. Can they or our California friends give us some of this earth for distribution to subscribers? We shall see.

Laboratory Dish.—An invention of Dr. Coplin of Jefferson Medical College is figured in Science, Sept. 24, 1897. In taking slides through various reagents, the section is liable to be scratched or destroyed by coming in contact with other slides. This dish is provided with grooves into which the slides can be set and so kept apart. Economy of reagents, absence of evaporation and solidity are also claimed for the invention.

Examination of Suspected Documents.—Blares, in an article on this subject, in the Journal de Pharmacie, recommends the use of two liquids with which he moistens the places on the documents at which it is suspected that a forgery has been committed. The first of these liquids consists of 1 part of castor oil dissolved in 6 parts of alcohol of 95 per cent. This is painted on with a camel's hair pencil, the effect being to make the paper partially transparent, and thus to bring out traces of erased writing. The second application consists of 2 percent aqueous solution of caustic soda. The operation of this liquid depends upon the methods of the falsificator. As a general thing, the latter removes a single figure from a number. In order to bring back the horizontal line, a portion of which he must almost necessarily remove, and to repair any damage done to the surface by the process of scraping or shaving,

he covers the spot with a coating of sandrac varnish. If the injury has been very considerable he repeats the operation on the opposite side of the paper. This varnish gives the paper back, to a large extent, restores the paper to its natural appearance, and, besides, gives it a surface upon which he can write or print without fear of the ink spreading. The figure put in the place of the one erased does not rest on the paper, however, but on the layer of varnish, and on this fact rests our ability to remove the counterfeit figure without interfering with the genuine ones that remain. An application of the second fluid effaces the printed figure. In this manner Mr. Blarez has succeeded in demonstrating some of the cleverest forgeries.

New Use for Paraffin.—Some chewing gum on sale in England and containing paraffin was labelled "for chewing only; not to be eaten". One child died of peritonitis after swallowing some of this gum.

To Cut Ring.—Through a square piece of wood pass three pins; one in the center projecting a trifle further than the other two. That one acts as a central pivot while the other two are cutters. If a handle is fixed to the wood and the long pin made to pierce the celluloid or other substance to be cut, the tool can be revolved around this central pivot and the cutting pins which are placed at a proper distance for the center will describe circles. The radius of the circle to be cut will determine the distance from the central pin to the cutters. Rings may be made in this way in large numbers without expense. If the substance being cut up is too thick, cut partly through, turn it bottom side up, insert the pivot pin in the hole already made and cut till you meet the former circular cutting which you are sure to do with exactness if care is used.

Tobacco Seeds.—Last summer an Agassiz student saved and weighed the seeds from a single pod. The weight came to 44.304 grammes. By count and weight it was found the one hundredth of a gramme contained 450 or, that one weighs .00002 of a gramme. Hence the 44 and more grammes contained 1,993,680 seeds.

To Split Selenite.—The method adopted by Professor Gates for sectioning animal cells has been applied for some time to splitting selenite plates. It consists in cementing them to glass and splitting off very thin pieces which are afterwards released from the glass by heat or other solvent of the cement. Take for example a flat piece of something less than an inch square and for practice split it down to a fortieth or a fiftieth of an inch in thickness. Glue or even mucilage will do for the cement. With a fine, thin and sharp blade detach as many layers as possible till at last you leave an extremely thin slice attached to the glass. Detach with warm water or other solvent of the cement. Cement other pieces to the glass ad libitum. The Nichols prism and crystalline objects will answer to test the proper thickness or thinness reached.

To Mount Pollen.—Digest in a warm place, in a well corked bottle 4 drams acacia, 3 drams glycerine, 3 drams pure water, thymol $\frac{1}{3}$ grain. Filter or else strain the completed solution through very fine linen or silk. Hurry it by more heat if desired. Clear the solution of all dirt residue and air-bubbles. Having this as a mounting medium use white zinc cells and finish as usual. This will do not only for pollen but for starches and other objects.

RECENT PUBLICATIONS.

Clinical Diagnosis by Means of Microscope and Chemical Methods.—Charles E. Simon, M. D., 2d ed., 133 cuts and 14 lithographic plates. Lea Bros. & Co., 1897. This is an up-to-date book on blood, urine, feces and other things where the microscope may play its part.

Essentials of Bacteriology.—By Dr. M. V. Ball, 218 pp. \$1.00. The 3d Edition has just been issued by Saunders, Phila., and gives the characteristics of 275 bacteria.

Lea Brothers & Co., of Philadelphia have just published a new, fourth edition of Abbott's Bacteriology of 543 pages with 106 illustrations. Chapters are added on the bubonic plague, influenza and gonococcus. Price \$2.75.

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A Glass Stage Plate with Rectangular Movements.

BY K. N. CUNNINGHAM.

The need of rectilinear motions in transverse directions, gave rise long ago to the mechanical stage; how to make a substitute may not be inopportune. Procure a smooth, even-surfaced strip of good quality, window-glass, 8 inches long, $3\frac{3}{8}$ inches wide, and $\frac{1}{8}$ inch thick. Cut it neatly into two pieces of equal size ($4 \times 3\frac{3}{8}$ inches). Use one as the base plate, the other to cut into three pieces. but one a narrow strip of 1 inch in width, leaving the two other pieces of equal size, say $3\frac{3}{8} \times 1\frac{1}{2}$. The 1 inch strip, must be shortened to $2\frac{1}{4}$ inches in length, this piece to be known as the slide carrier. After the four separate parts are prepared, their edges should be evenly ground with wet sand on a flat piece of sandstone. This gives the

plate a smooth touch and prevents the edges from getting nicked. A slantwise grinding will put a slight bevel on the harsh edges. The final grinding is done by holding the glass perpendicularly while rubbing over the stone. The edges are smoothed on a finer grained stone without sand.

The four pieces are then ready to be put together. Get a small quantity of liquid glue, to which a little chalk, clay or tripoli, has been added to make it pasty. It will dry speedily, say in a few hours, while simple glue might not harden for several days. Place a small circular spot of the glue an inch wide at each of the four corners of the larger plate, a little away from the edges. Adjust the next two larger pieces of glass accurately to the upper outer corners of the under plate. This done, the inch wide glass carrier piece is placed between them, and carefully adjusted for parallelism, and sliding contact free from lateral play. The plate is then set aside for the glue to fully set and to lose every indication of shifting under side pressure. The inch-wide sliding piece may now be removed for the addition of the slide or slip holder frame. This is made by taking a piece of stiff pasteboard a little thicker than an average glass slip, and superposing on it a 1 x 3 slip, and cutting through the cardboard so that the slip will drop into it snugly. Outside of this space the pasteboard carrier frame may be $\frac{1}{8}$ inch wide all around. This pasteboard skeleton is glued squarely across the middle of the glass carrier piece. This completes the slide carrier and the glass stage plate. With the slide carrier in use, a 1-6 objective offers an air clearance space for the slide to pass freely, to and fro.

It is useful to locate on the upper surface of the left half or side of the plate, a reference line to continuously bisect the center of the field of view of a 1-6 objective. To calibrate this line, and indicate it on the glass plate, the glass plate is laid squarely on the metal stage of the

microscope, and its inner edge held firmly in contact with the brass pillar supporting the stage and tube. Be careful that both sides of the glass plate are parallel to the middle diameter of the field of view; then lay on the glass plate, a thin glass slip whose edge must be adjusted so as to bisect the field of view longitudinally to the edge of the slip after its edge has been focussed on by a 1-6th objective. Compress, and retain the slip in position. Carefully remove the stage, and by the aid of a small diamond trace a line along the edge of the slip on the left side of the stage plate. Or, a fine splinter of flint, or carborundum will serve to scratch the line. If this is done properly the line may be shoved through the field for a full inch or more being continuously in view in a field of 2-100ths of an inch. This line once established on the plate becomes a guage or recording point for all objects on a cover glass mount of one inch area within close limits. Additional benefit is derived from tracing such a line on the rigid metal stage plate. The line traced on the metal plate must, if prolonged, pass through the center of the field of view, when limited to the field of a 1-6 objective.

The same line also becomes a guage line, enabling the field of any object to be recovered subsequently. In order to utilize this line at its full value, it is necessary to make an easily seen dot on the axis of the line at a distance of one inch from the center of the field of view, this line and its point is fixed on the left hand side of the metal plate, being the equivalent of the fine line on the glass plate when used above it. The index dot may be fixed by a few trials, while the glass plate with its guage line is in position on the metal stage. The dot should register under the line at an inch from the center of the objective.

Assuming that these two guage lines have been properly traced on the glass and the stage plate, one can then

test its registering action for particular objects in a mount of a square inch of area or less. Placing the glass stage plate in position on the metal stage, a mount of strewn diatoms is placed in the sliding carrier. A momentary examination may show some single object of interest and this is brought to the center of the field of view. Allow the object to remain there for a moment, while with a pen you put a dot of black ink exactly over the guage dot traced on the metal stage plate. Repeat this for any other objects that may be noted to the limit of five or more. If the mount is now set aside the ink dots register, on the slide, the several fields of the objects so noted and may be found at any subsequent time. This is the widest application of the combination of the two straight lines and is a means of locating the intersection of two co-ordinate lines at the point of their intersection from the fixed center of the objective in use. If one ignore the guage dot, the position of any object may be closely registered by the aid of the single line or directrix marked on the glass stage plate. Any object noted in the mount is brought to the center of the field, and allowed to rest there a moment. An ink dot is made on the slide at any point along, but immediately over the line. If after doing this the slide is run out of the field of view, on again placing the ink dot above the reference line, the whole glass plate is slid carefully through the field when the object is likely to be found by a slight oscilation of the slide while passing through the field. Since the real field under a power of 500 diameters may be 2-100ths of an inch, the shifting amplitude of the slide carrier should be very minute. In the vermicular shifting of a slide by hand in the usual way in a field of 500-600 diameters the act might consume ten minutes before the desired object could be found.

To explore slides without missing a particle of their contents, it can be used this way: Any histological or

diatom slide may be placed on the plate carrier, and the stage axis tilted 45 degrees if the stand is not rigid. Then rest the glass plate on the metal stage. The slide carrier may be slid up and down fifty times in ten seconds by the right hand, while the left hand pushes the glass stage plate across the field in an unvariable horizontal course by impulses of one thousandth of an inch or less. By this means not a speck can escape scrutiny.

Another valuable use of the glass stage plate is that by placing a slide on it, on whose surface is a liquid containing diatoms, a moving diatom once in a field of a 1-6 objective may be kept there and its movements studied for hours at a time. The movable stage being of suitable weight may be constantly shifted for long intervals without causing a jar or tremor of the slide. The slide itself is not touched after being put in position on the plate. A small hemispherical condensing lens can be easily attached to the under side of the plate by a liquid contact, and a strongly lighted field can always be had by turning the light from the concave mirror onto the lens.

On Double Color Illumination.

It is possible with substage condenser and iris diaphragm to so light a diatom as to reveal the primary structure in one color and the secondary in another. Heretofore workers have used cones of light greatly exceeding the aperture of the objective or else cones very much smaller than the aperture of the objective. The former was on the dark ground principle—the latter involving diffraction. But Mr. Rheinberg has found a plan for getting rid largely of diffraction color effects and for using any cone of illumination desired. Just as in low-power color illumination on the dark ground principle, he places in the substage condenser one of the ordinary

double color discs having a central spot of one color surrounded by a ring of a strongly contrasted or complementary color. He prefers a red centre and a green periphery. By means of the iris diaphragm, the relative proportions of the two colors are so regulated that in looking through the lenses the light appears to be of a neutral tint. This arrangement is suitable for use with high power objectives.

Recent Diatom Discoveries.

A long-shaped aperture in the nodule of *Navicula rhomboides* has been found by Mr. Nelson using Powell's apochromatic adjustable condenser. Pipes and a central spot in the nodule had been before seen but no aperture in so small a species of *Navicula* as the *rhomboides*.

In the diatom *Biddulphia elaborata* the termination of the stalk is called "the rose of the diatomic watering pot." Attached to the oval periphery of the valve is a rim only .00041 of an inch high. The general appearance of the valve can be compared to an oval tea-tray having a convex mound in the centre as high as the rim and a pipe with a watering-pot rose top rising up a little distance from the ends of its longer axis. The close-set papillæ which are small pipes analogous to the perforation in the nodule of a *Navicula* rise from the centre of a crater which is at the top of an elevation in the middle of the valve. The edge of the crater is level with the top of the rim round the periphery of the valve.

The ridges radiating from the center of the valve between the rows of large areolations are caused by a thickening of the silex, being located in the thinner part of the silex. On the thick ridges between the rows of areolations are intercostal dots. They are very irregular and many are missing.

This diatom has been supposed to lack a finely perforated membrane except on the conical side and convex top of the rose of the watering pot. The new Powell condenser, however, reveals it. It can only be seen by means of a direct axial cone of maximum dry aperture.

In *Auliscus sculptus*, Nelson has at last succeeded in resolving the rose pattern in the processes of this diatom. It was found in *A. racemosus* in 1891 which led to the supposition that it existed in *sculptus*. It is exceedingly fine but it is there. *Sculptus* also has very fine perforations in its beautifully fine sculptured border. All the above diatoms were mounted in balsam. Some discoveries have also been made in *Actinocyclus ralfsii* and in *Eupodiscus argus* by Mr. Nelson who recently reported them before the Quekett Club.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON.

CLEVELAND, OHIO.

MOUNTING UNCINULAS.—The quickest and best way to mount these beautiful fungi is to preserve them unstained in glycerine jelly. They show best when temporarily examined in a drop of water but jelly is the next best thing. Few prettier specimens can be found for a cabinet. Though generally unknown and unseen it is almost impossible to pass through the woods without trampling them under foot. They are found on the leaves of *Tillia americana*, grape leaves, Virginia creepers, bunches of grapes, on maple, elm, and other leaves.

EXHIBITS.—When invited to exhibit slides to a mixed company, the majority of whom are not scientists, do not take technical specimens but take the prettiest slides

you possess. A handsome slide under an inch objective will excite more than a triumph of manipulation under a one-tenth. The beak of a mosquito will produce a total eclipse of *Bacillus tuberculosis*. It is unwise to use high objectives at such a soiree.

SCLEROGEN.—This tissue is finely exhibited in the grit of a pear. With a penknife, cut as thin a section of a ripe pear as possible. Place the section on a glass slip, under a thick cover. Press out the section and examine. To press out, wrap the finger with a clean handkerchief. The naked finger would grease and soil the cover. The specimen is easily prepared and is well worth examining.

EDITORIAL.

Image of an Image.—Dr. T. O. Reynolds writes that 14 years ago he experimented in the line that Gates has succeeded in. He had a B. and L. Investigator and another inferior instrument with which he tried to get an image of an image. He was discouraged because he did not get the focusing of the second instrument accurately determined. He overlooked the fact that the attenuation of light, due to the extreme magnification, rendered the image, which was really there, invisible to the human retina. He has always believed that it would be accomplished, and that the molecule and atom would be revealed as plainly as the markings of *Pleurosigma*. He was therefore in the opposite mood from those silly egotists who have ridiculed the matter in the petty prints of the day, and hails with entire credence the announcement that Gates has by long exposure of a sensitive photographic plate got the cumulative action of light which the eye could not gather. He looks for an unlimited expansion of our powers in this way.

Fish Commission.—*Natural Science*, of London, announces a long list of appointments to professorships and govern-

mental positions, zoological and botanical, and throws into the list—"a person named Bowers, from Martinsburg, W. Va., to be U. S. Fish Commissioner." The work of the U. S. Fish Commission is by law largely practical, statistical and economic. Of course zoologists and ichthyologists who care little for what is outside of what they call "science," would have preferred to welcome some college professor to this position. But Professor Baird, the founder of the commission, set the precedent by recommending as his own successor "a person named" Ferguson. President Cleveland appointed "a person named" Brice as commissioner, and the present appointment continues the divorce of fish hatching from embryology, classification and museum collecting. The new commissioner would do well, however, to call to his aid men of science who can work with practical ends in view. Perhaps money has been wasted in the past from too severely ignoring practical men of science and from assuming that men of science must of necessity be unpractical.

Testing Tuberculous Milk.—At Owen College, London, Prof. S. Delepine takes the milk directly from a single cow into a sterilized vessel and avoids all mixing. In the laboratory 80 c. c., of the milk are centrifugalized in two stout cylindrical test tubes holding 40 c. c. each. The tubes are sterilized by steam. A centrifugal machine giving 3,000 revolutions per minute is used for 15 minutes. The tubes are kept closed with an india rubber cap till the moment they are used. When the centrifugalization is completed the thickness of the layer of cream and the diameter of the sediment are measured, the color of the milk and sediment are told, and the reaction and specific gravity of the milk in the bottle are taken. Microscopical preparations are then made with the cream and sediment of the prepared milk. One drop of cream is taken with a sterilized platinum loop, spread on a cover glass and allowed to dry. The cream, together with the milk, is then removed by means of a wide pipette connected with a vacuum apparatus. This is done with the tube standing vertically and without disturbing the sediment. When

only a thin layer of milk remains the tube is inclined gently so as to expose the sediment which adheres firmly to the bottom of the tube, and a small drop of it is taken and spread on the cover-glass. This is done with a platinum loop holding 2-3 milligrams. Several cover-glasses are prepared in this way. Drops of cream and sediment can then be examined at once for the detection of cells, foreign bodies and motile bacteria. The other drops spread in thin layers are allowed to dry, are then passed three times through the flame of a Bunsen burner, then left 20-24 hours in a mixture of equal parts of ether and absolute alcohol. At the end of that time the alcohol and ether are heated over a water bath to complete the extraction of the fat, the cover-glasses are taken out, washed with absolute alcohol, and are then ready for staining by one of the usual methods. If they are stained for tubercle bacilli, the Ziehl-Neelsen method is best. If the staining be with aniline dye for special purposes the film should be submitted first to the action of a dilute acid for a few seconds. Sulphuric acid, 10 per cent is good. If acid is not used, the proteid matter coagulated on the cover-glass, in the spaces between the fat glands, stains deeply, and neither micro-organisms nor cells can be seen distinctly. This permits obtaining a permanent preparation which shows clearly the number and size of the fat globules. Immediately after preparing the films two guinea-pigs are inoculated, each with the sediment of 40 c. c. of milk. The sediment contained in each tube is mixed with a little of the supernatant milk so as to make a total quantity of 2 c. c. for subcutaneous injections, and 5 c. c. for peritoneal inoculations.

Fine Meshes.—If No. 20 miller's silk, which is regarded as the best kind, be used to collect plankton, it is important to remember that not all organisms are stopped by it, and that while new silk lets many forms go through, after it has become clogged with diatoms, etc., less forms will pass its meshes. It is not at its best when new, and after reaching its best it begins to wear out. This suggests using a double bag for straining drinking water, catching

with the older and better silk what goes through the newer. Estimates of quantity taken are therefore not to be taken as infallable.

A Local Society.—The Central New York Microscopical Society has been dead for years. It never was very enthusiastic, and would not have lasted so long as it did but for the place of meeting in Syracuse having been furnished free of charge by Dr. Robert Aberdein. Some of the amateurs left microscopy and went into the Camera Club to practice photography. Has not this been the case elsewhere? How will Syracuse, without any local society, get on when its turn comes to entertain the A. M. S.?

Washington Society.—The February meeting occurred February 9th, when the vice-president, Dr. Robert Reyburn, read a paper and gave lantern slide illustrations on the life-history, and character of the principle forms of bacteria with which medicine has to deal. Some eight or ten members were present. Mr. A. A. Adee is president for 1898; Mr. H. H. Doubleday, corresponding secretary; Mr. L. M. Mooers, recording secretary, and W. H. Seaman, curator. This society has no expense for rent, light, or heat, all these being given gratuitously by Dr. Reyburn who has been one of the oldest and most faithful of its members. Its dues are, however, prohibitive to some people. It will be remembered that Dr. Reyburn was one of the physicians that attended Garfield during his long suffering in 1881.

Subscribers.—There are a few people who read our journal regularly and, we much regret to say, are unknown to us because they take the journal through some dealer who thinks it to his interest to conceal their names from us. We have a communication of interest to them if they will kindly forward their names and addresses.

One or two subscribers have made themselves heard quite loudly today because of an unintentional oversight. We beg you all to be patient, and to politely remind us of any seeming neglect. Remember that we have hundreds of people to write to while you have but a few.

Flour.—At the recent meeting of the Indiana Academy of Sciences held at Indianapolis, Ind., December 29th, 30th, C. G. Ferris read a paper on "Micro-organisms in Flour." A. W. Bitting read one on "New Apparatus for Photomicroscopy," and one on "The Number of Colonies of Bacteria and Moulds Formed by Testing Air, Milk, and Water by Different Culture Media."

Diatoms.—At the annual meeting of the Nebraska Academy of Natural Sciences, held at Lincoln, Nebr., November 26th, 27th, Dr. E. H. Barbour read a paper on "Our Beds of Diatomaceous Earth and Their Associated Fossils." J. P. Rowe spoke on certain "Peat Beds and Their Underlying Diatomaceous Deposits."

Government Position.—On February 23d an examination was to be held for the position of assistant microscopist in the Department of Agriculture. It was announced that only women would be eligible. Some of the "equal rights" women are complaining of the unfairness of limiting this to one sex, even though it be their own. They wish all kinds of differences between the occupations to be broken down and a free competition between the sexes.

The Observer.—From 1890 to August, 1897, Mr. E. F. Bigelow published this monthly containing a microscopical department, at Portland, Conn. He has some back numbers to dispose of very cheap—from 40 cents to \$1 per volume, odd numbers 5 cents. In a sense back numbers are as valuable as current numbers, and are useful for reference. He also offers his "Plant Analysis" blanks, in books, in portfolio, or separately. Address him in care of this journal, or see his advertisement in *Popular Science News* into which *The Observer* was merged last August.

Duty on Slides.—A subscriber asks if there is any duty to be paid on Hornell's slides coming from England. They have been sent into this country to a good many people without paying duty, and it is not probable that duty is ever demanded. If it should be in any case, refuse to pay it and appeal to the Secretary of the Treasury explaining

that microscopical slides are specimens of natural history objects.

SCIENCE-GOSSIP.

Amplifier. — Thirty years ago Dr. Woodward, of the Army Medical Museum, was deeply interested in perfecting the art of photo-microscopy. The device of introducing into the body of the microscope an amplifier was so successfully carried out that he was enabled to obtain a greater and more accurate amplification or magnification of the object with a Wales one-sixth than was possible with the Powell and Leland one-fiftieth. A micro-photograph of a frustule of the diatom *Pleurosigma angulatum* had its markings so resolved by the one-sixth plus the amplifier that they were shown to be hemispherical bosses of silica rather than hexagons, as the one-fiftieth and all other lenses then known made them appear. The result was owing to the superior resolving power of the one-sixth plus the amplifier. A second microscope is infinitely superior to an eye-piece for the amplification of the "real" image. But how do we get it collected. "The line of light falling on the photo-salt in the film spreads by molecular irradiation over more area than the actual width of the line of light, and there is also diffused reflection of this line of light by the semi-transparent substance of the film. To these two causes is due the fact that when the details of two structures are too close together in an image of an object these structures will photograph as one, and thus the detail will be lost. If the new details are to appear the image must be enlarged before it is photographed."—Gage.

Epithelioma.—Dr. Hartzell reports a case in University Hospital, Philadelphia, of a sixteen-year-old boy who carried a pea-shaped ulcer above his cheek for two years. Microscopic sections were made from the border of the ulcer. They revealed a neoplastic structure consisting of fibrous stroma in which were numerous irregular-shaped branching tracts of columnar epithelium, and a round-celled

infiltrate separating the neoplasm from the healthy tissue. A forty per cent plaster of pyrogallol was applied for two weeks. Then boric acid ointment produced rapid healing. A small ulcer on the edge of the nostril was excised and microscopically proved to be much the same in structure. These ulcers are almost unknown in the young, and but for the microscope probably would have been misunderstood.

Gastric Ulcers.—In a recent case complicated with erosion, microscopical study showed that the mucous membrane of the stomach was affected with numerous necroses which could be attributed neither to anemia, bacteria nor blood infarction. They were approximately one millimeter in depth.

RECENT PUBLICATIONS.

Morbid Histology.—A text book on this subject, by Professor Boyce, of London, is published by D. Appleton & Co., New York, at \$7.50; pp. 477; colored illustrations, 130.

Tariff.—The Dingley tariff law is in pamphlet form and may be had by sending five cents to W. F. Wakeman, 135 W. 23d street, New York City. Those who contemplate importing instruments, slides, books, or anything else need it.

Whist Opinions.—This is a new paper which will interest all lovers of the American game. Address, Box 761, Baltimore, Md.

Ormsby's Geo-Helio Ephemeris is an astrologer's almanac for 1898. If interested send 50c. to the Planetary Publishing Co., 169 Jackson street, Chicago. Best almanac printed.

Photomicrography. — "How to Photograph Microscopic Objects," by J. H. Jennings; for sale by the Outing Co., 239 Fifth avenue, New York. Price in cloth, 75 cents, post paid.

MISCELLANEOUS.

Wanted.—1-12 to 1-16 immersion objective, 1.30 to 1.40 N. A., adjustable. Address, Dr. Studebaker, Springfield, Ohio.

For Sale.—At London price, a Swift's Bacteriological Microscope, Crookshank pattern, with high angled lenses and Abbe Acromatic Condenser. In perfect order and nearly new. Particulars from A. H. Thomas, M. D., 611 Taylor street, San Francisco, Cal.

For Sale.—A Hartnack microscope in good condition, three oculars and five objectives, including one immersion. Price \$50. Address, W. Adler, care of this Journal.

Slides.—The estate of a deceased physician offers 700 slides for sale at \$10 per hundred. Also, Beck Binocular and six objectives and other accessories worth \$350.—E. E. W.

Exchange.—Arthur Donnelly, Davisville, R. I., wants to exchange a new French microscope, with case, for which he paid \$6, for bird skins or books on taxidermy.

Redondo Beach Diatoms.—One of our Austrian subscribers wants genuine Redondo material, 4 or 5 kilograms, and no other California earth. Will give in exchange celebrated European and Asiatic material, fossil marine, or if necessary, will pay cash. Address, J. C. Rinnbock, care of Journal.

Wood Sections.—Send to R. B. Hough, Lowville, N. Y., for sample of his sections of wood, 1-1200 inch thick, showing three distinct views of grain under each cover glass.

King's Slides.—We have just received a beautiful collection of slides from J. D. King, Ph. D., of Cottage City, Mass., and think they ought to please the most exacting. Send for his catalogue. Located on the very best part of the Atlantic coast he has unexcelled opportunities to gather marine specimens.

Leidy.—A copy of Fresh-Water Rhizopods of North

America, with its 1,190 colored figures, is offered by one of our correspondents in Albion, N. Y., for \$4.25. The book is rare and now hard to get. This is the only copy we know of on sale.

Walter White's Botanical Specimens.—Now we are ready to send complete sets of the beautiful microscopical objects. Please send new orders.

General Index.—If you have not had the general index to the first sixteen volumes of this journal please write immediately for one, and state which volumes you have preserved.

In German.—We have some extra copies of *Zeitschrift für Angewandte Mikroskopie, von G. Marpmann, Leipzig*, to send free to those who wish to see sample copies.

Books.—A subscriber asks about John Phin's publications. Send to the Industrial Publishing Company, 16 Thomas street, New York, for list of Phin's books and other microscopical publications. They are all cheap but not the latest published.

Royal M. Society.—At the meeting on January 19th, the president reviewed the progress of Microscopical Science during 1897, and gave an account of the manner in which achromatic doublets and triplets are practically calculated.

Personal.—Prof. Jeffrey Bell, one of the secretaries of the Royal Microscopical Society is to be succeeded by Dr. Hebb.

Medical Journals.—There are 275 medical journals in the United States. Combined circulation, 16,017,200 copies.

Personal.—Lyman M. Ellis, M. D., is lecturer on Histology in the Gross Medical College.

Arnold S. Taussig, M. D., is instructor in Microscopical Diagnosis in the Gross Medical College.

George N. Carpenter is editor of the *Irish Naturalist*. We shall be pleased to forward requests for sample copies if written on 2-cent postal cards and sent to us under cover with remittance for subscription due us.

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The Eye of Pecten Irradians or the Scallop.

BY F. A. ROGERS, M. D.

A general study of the great and important sub-kingdom of the animal creation, the Mollusk, reveals many new and strange things to the lover of nature, while some of the minute rudimentary forms of the special organs of sight, hearing, taste and touch which Mollusks possess make very interesting objects for microscopic examination. As we look at the clam, oyster, scallop, snail and the multitude of forms belonging to the Mollusca the inquiring mind often wonders how much of what is going on around them do they perceive and by what means if any is light, sound or taste, any or all of these communicated to these organisms. In some forms the special organs of sense are more highly developed than

in others and where there is no special need either from habits or surroundings for them we find very primitive organs formed and developed. It will pay to carefully inquire into the existing special conditions which are found in many of these forms and which led the writer of this article to carefully study the make-up of a very common Mollusk found abundantly on the shores of Cape Cod and which is popularly called the "scallop." A cursory observation of *Pecten Irradians*, or the scallop, with its scalloped edge from which this Mollusk derives its vulgar cognomen and the varied hues of the curved lines on the outside of this bivalve presents a very unique appearance.

But a view of the hidden beauty which lies within can only be observed after careful study and some painstaking research.

There are two great divisions of Mollusca, the *Glossophora*, (Mollusks with head region prominently developed and always provided with an odontophore or rasping tongue) and *Lipocephala*, or Mollusks with undeveloped head region (acephalous) and which have no cephalic eyes or rasping organs.

The *Pecten* belongs to the Family *Ostracea* which includes the edible oyster and is a division of the Order *Monomya* which has for its special characteristics the facts that the Anterior Adductor muscle is absent and there is no siphon as is the case with the clam. It has however a large Posterior Adductor muscle which is much prized as an article of diet and to obtain which millions of the mature organisms are yearly sacrificed.

Again the Order *Monomya* comes under the class of the *Lamellibranchia* which may be defined as a *Lipocephala* or acephalous Mollusk having ctenidia or gills in the form of layers disposed symmetrically, two on each side of the bivalve.

In some *Lamellibranchia* although there are no ce-

phalic eyes yet special organs of sight are developed on the free margin of the mantle-skirt; such is the case with the scallop.

In the living state under water, just within the margin of each valve may be observed a row of minute points of great brilliancy, sparkling like diamonds, each surrounded by a dark ring of epithelial pigment. These are the eyes provided for the use of the Pecten by which its active movements are directed, for this Mollusk has the power of rapid swimming by opening and shutting the valves of the shell.

Each eye is a beautiful structure provided with a sclerotic coat, a transparent cornea, pupil, crystalline lens, retinal body, optic nerve, in fact everything that would necessarily enter into the composition of a good organ of sight.

Quite different is the make-up of this eye from some of the primitive eyes of the Cephalopods in which we should naturally expect to find highly developed sensory organs but which in numerous instances are simply a pair of hollow chambers opening to the exterior by minute orifices (pinhole cameras) and perfectly devoid of any refractive structures.

We can account for the more complete structure found in the Pecten only by studying its origin and development.

The development of the eye of some Mollusks shows that it is simply a modified area of the general epidermic layer and that the sensitiveness of its cells to the action of light and their relationship to the nerve-filaments is only a specialization or intensification of a property which might, as far as we can see, occur anywhere on the general surface of the body.

The primitive optic vesicle is said to arise as a pit or depression in the epiderm and the integument around it rises in the form of a ring-like upgrowth gradually con-

verging so as to enclose a spherical chamber, devoid of lens and cornea in some instances, but having a minute hole communicating with the outside and filled with sea-water during life.

The eyes of *Pecten* however originated not as pits or depressions in the exterior membrane but as tentacles and while in the cephalic eyes of Mollusks the fibers of the optic nerve join the posterior nerve-end cells; in this instance the optic nerve penetrates the capsule of the eye and passes in front of the retinal body so that its fibers are inserted into the anterior aspect of the rods as they are in vertebrates.

Again the lens in the eye of *Pecten* is not a product of the cuticle as is the case in most Mollusks where the closed cavity is wholly or partially filled with a refractive body, the lens being secreted from the walls, but is a cellular structure which again corresponds with the eyes of vertebrates.

Thus we note several points of agreement in the eye of this Mollusk with those of higher organizations and by carefully manipulating a portion of the mantle-skirt containing the eyes we can demonstrate these facts for ourselves.

In order to study the eye, small portions containing one or two eyes and not over two or three centimeters thick should be cut from the mantle-skirt and properly treated by fixing, hardening, embedding, cutting, staining, etc.

To show the retina the best results will be obtained by fixing in a 1 per cent solution of Osmic Acid, although excellent general results may be had after fixing in 40 per cent sol. Formaldehyd or a saturated aqueous solution of Mercuric Chloride. After fixing with Mercuric Chloride the tissue stains beautifully with Borax-Carmine, but no staining whatever is required if the tissue is fixed and hardened in Osmic Acid.

Embedding in Celloidin will give good results but not to be compared to the Paraffin method when properly manipulated, in beauty of detail, as well as mounted consecutive sections, which are needed in the study of this eye.

There is a considerable variation in the number of eyes found in this bivalve, for while in some as low as 64 have been counted, in others over 100 have been found. Perhaps the average number would be found between 84 and 96. The eyes are distributed quite evenly along

the free surface of the mantle. There is also some difference in the size of the eyes in each individual scallop; those which are placed where they are of the most use in seeing being largest in size, though not more perfect in their component parts. The mantle when touched or irritated contracts taking the eyes with it so that although there are no special muscles of motion attached to the eyes yet by the contraction of the mantle they may change their relative position to the objects which surround them. The surface of the eye is everywhere surrounded by pigmented epithelial cells except the co

which has a single layer of transparent pavement epithelium on the surface.

The shape of the interior of the eye which includes the organs of vision is nearly oval. It is longer in the equatorial than in the polar diameter, measuring 1.40 by 1.50 of an inch and it is surrounded by a choroid coat which becomes continuous with the cornea. On polar section the interior of the eye is seen to be divided into two nearly equal parts by a beautifully curved line formed by the expansion of the optic nerve. Fig. I, E.

The anterior portion or chamber contains nothing but the lens which occupies nearly the whole of it. The posterior chamber contains the complex structure of the retina, tapetum and pigment and all these collectively are situated in the end of a tentacular portion of the mantle. I shall now give the details of the several parts separately as the result of my observation.

THE CORNEA.—The tissues of the cornea are arranged in two layers; an outer pavement epithelium and an inner or true fibrous layer of the cornea. The membrane of Descemet and the internal epithelium or endothelium are wanting. The cornea simply resting upon the lens without the intervention of aqueous humor. In shape it is circular and at the periphery or margin it is continuous with the choroid coat and tentacular portion of the eye.

It measures 1.80 inch in diameter. (These measurements are for average eyes). The external or outer layer consists of a single layer of nucleated pavement epithelial cells elongated in a direction perpendicular to the surface and situated directly upon the corneal tissue. In a stained section it appears like a row of beaded cells as a margin to the cornea. The cornea seems to be made up of a fibrous structure with very fine communicating channels which may be seen upon cross-section of eyes treated with Osmic Acid also by gently scraping the epithelium from the surface and impregnating with Gold

Chloride. It does not appear to be supplied with nerves although nerve filaments may be seen running to the very edge of the cornea and communicating with the pigmented epithelial cells surrounding the eye.

THE LENS.—The lens is an oblong, oval body and occupies nearly one-half of the globe of the eye. I have never been able to make out any capsule. If one exists it must be exceedingly fine. It seems to simply occupy the space between the cornea anteriorly and the expansion of the optic nerve posteriorly. Its structure is cellular, being made up of irregular, polygonal, nucleated cells.

The cells along the front border are larger than the others and more nearly round while those around the margin and back toward the retina are oblong and spindle shaped. There is no space between the lens in front and the cornea and it appears posteriorly to lie in close opposition to the ganglion nerve cells of the inner border of the retina, or the *membrana limitans interna*.

The equatorial diameter of the lens is slightly greater than the corneal opening, the average measurements being 1-50 inch long, or in the equatorial direction, and 1-100 inch, thick or in the polar direction of the eye. In fresh eyes the cells of the lens are nearly regular, hexagonal in shape, united together at the edges. In the central portions the cells measure 1-1200 inch in diameter; on the outer edge from 1-1000 to 1-800 inch in diameter while the longer cells measure 1-2000 inch wide by 1-500 inch long.

THE OPTIC OR RETINAL NERVE.—Along the border of the mantle there is a nerve which runs just back of the eyes, and from this nerve are given off branches, one of which runs to each eye. Just previous to its approach to the eye it divides into two nearly equal parts one of which is the retinal or optic nerve proper. The optic nerve maintains its integrity although it pursues a tortuous

course and follows the curve of the eye, at first being wholly on the outside of the choroid but as it advances it sinks itself into and through this coating until it encroaches upon the retina. Fig. IV., B.

It continues until the equatorial diameter of the eye is reached when it turns at a right angle and passes directly across the eye just back of the lens where it expands and becomes the inner layer of the retina. The branch from the optic nerve which is known as the complementary nerve, runs a short course to the back of the eye where it divides and subdivides into numerous branches which spread out on the outside of the choroid, where in the vicinity of the equator of the eye they appear to be distributed very evenly, as seen on cross-section, in collections or bundles. The further divisions may be traced to the pigmented epithelium of the tentacular portion of the eye where they end in very small corpuscular bodies from which exceedingly fine wavy filaments extend to the individual pigmented cells. Fig. III. Branches are also given off which penetrate the choroid coat. This branch is evidently a nerve of general sensation while joined with it back of the eye is one of special sensation, or the optic nerve.

THE RETINA.—Of special importance and interest is the study of the retina. The ordinary methods of hardening and staining do not well show the retina for the picture is very much distorted, the rod and cone layer is destroyed or lost to view, but by hardening in Osmic Acid and taking special pains in the further manipulations I have slides which are beautifully correct in all the details.

By this process the retina is shown to be composed of three principal layers; an internal nervous layer; a middle, nucleated spindle celled layer, and an external club shaped, palisade-like layer. The internal border of the retina as seen on polar sections of the eye is limited by

the beautifully curved line which is the membrana limitans interna. Immediately back of this layer is found the ganglion layer of the retinal or optic nerve which is composed of irregular shaped nucleated cells. Some of these cells have polar prolongations but as a rule it is difficult to make these out. In the center of the eye these cells are rounded or slightly oblong while at the periphery they assume an oblong shape and are larger. Next to the spindle celled layer the ganglion cells become smaller and appear to lie close to the ends of the spindle

Fig. II.

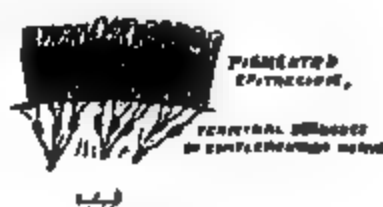


PLATE IV

— 1/100 —

cells with which they are undoubtedly continuous. The spindle cell layer is made up of long nucleated straight and bent spindle shaped cells which lie close together. In the central portion they are shorter but straight and the ends of the cells are simply rounded; while upon either side they appear bent and the ends are pointed. The cells in the central portion of the retina are arranged parallel with the polar direction of the eye but

as the periphery is reached upon either side they gradually assume a nearly horizontal or equatorial direction. They measure about 1-600 inch long and 1-4000 to 1-2000 wide. The outer ends of these cells form a beautifully distinct, regular, unbroken line; the *membrana limitans externa*, (Fig. I, M.,) and external to this is found the palisade layer which corresponds to the rod and cone layer in vertebrates. This layer is composed of irregular, long, club-shaped, non-nucleated cells which are arranged with their long diameter perpendicular to the *membrana limitans externa*. In the central portion of the retina these cells are coarser and shorter than upon the sides. The measurements of these cells are about two-thirds that of the previous layer. The free ends of these cells are distinctly rounded and club-shaped and no external segments are to be discovered but they seem to be surrounded by a homogenous fluid or very finely granular substance that fills the space between this layer and the tapetum which we next consider.

TAPETUM LUCIDUM.—Of peculiar interest in studying the eye of *Pecten* is the tapetum lucidum. It is a bright colored and apparently light-reflecting membrane situated directly back of the rod and cone layer of the retina. In eyes hardened by the various common methods it appears upon cross-section to be thrown into various folds and masses which do not assume any certain order. The best and most striking view of this membrane may be obtained in equa-sections of the eye after hardening in Osmic Acid. It then forms a very beautiful and interesting object for the polariscope. It is not necessary however to use a polariscope to view the beautiful coloring of this object for in posterior equatorial sections of the eye may be seen the broad annular ring of pigment in the center of which the angular, iridescent mass of the tapetum appears. By using transmitted light, rich rainbow colors strongly contrast this part with the sur-

roundings, appearing as it does like some crystalline object or laminated mineral substance which has been sectioned at a slight angle with the plane of cleavage. Brilliant blue, orange, and ruby red are the colors that predominate if transmitted light is used, while with a dark ground illumination luminous colors of a light blue, golden and pearly hues appear. The surface of a section of the tapetum made in the above plain appears under higher powers to be finely granular. The granules are arranged regularly in lines which cross each other at right angles giving the appearance of the markings seen upon some diatoms with a fineness and clearness about equal to *Pleurosigma* when mounted in styrax.

The tapetum is circular in shape and has the edge or periphery attached to the interior of the choroid coat of the eye and on a line about one-third the distance from the posterior portion like a veil hung across.

It does not, however, extend directly across the eye but the free central portion conforms to the globe of the eye so that on cross-section it is irregularly semi-lunar in shape. At the marginal attachment it is very thin but in the central portion it is 1-2500 inch to 1-1600 inch thick. The markings and iridescence do not appear on cross section but they do appear in teased portions of fresh eyes mounted in salt solution or acid glycerine.

PIGMENT.—The pigment layer is situated back of the tapetum lucidum, by which on the front it is bounded and on the back by the posterior portion of the choroid. The amount in different eyes varies. In some eyes it apparently occupies about one-fifth the distance from the posterior to the anterior part of the globe, being 1-250 inch thick at the center, while in other eyes it is not more than one-half as thick. The thickness and relative position it occupies to the other parts is best seen in polar sections of the eye, but a better idea of the composition may be had in equatorial sections. It

appears to be made up of granular pigment matter loosely put together with coarser and more dense, oval or irregularly shaped pigmented masses frequently scattered in the substance. By some methods of hardening the pigment appears not very unlike epithelial cells but such does not appear to be the case in fresh eyes or those treated with Osmic Acid.

The pigment rests posteriorly upon the choroid coat of the eye and the anterior portion is limited by the tapetum to which it adheres. In fresh eyes and those stained by the various methods the color remains the same, being a brownish red.

DESCRIPTION OF FIGURES.

Fig. 1. Polar section of eye. A, pavement epithelium; B, cornea; C, lens; D, pigmented epithelium; E, membrana limitans interna; F, ganglion cells of retinal nerve; G, spindle cells; H, rod and cone cells; J, tapetum; K, pigment; L, choroid; M, memb. lim. exter.

Fig. II. Diagrammatic sketch of the arrangement of the internal parts of the eye, from one pole to the other.

Fig. III. The arrangement of the terminal branches of the complementary nerve in relation to the pigmented epithelium.

Fig. IV. Equatorial section of the eye about one-third the distance from the posterior portion of the eye. A, pig. epithel.; B, cross-section of optic nerve; CC, cross-sections of complementary nerve; D, pigment; E, tapetum; F, retina.

Figures I, II, IV, were drawn with a camera lucida and are supplied with a scale.

Microscopic Billingsgate.

The following separate phrases are all taken from a recently published article professing to be a notice of Gates' Mega-microscope :

Here's richness—it is painful nonsense—to offer such stuff is an insult—with pain tempered by uncontrollable laughter—without malice. May I presume to ask, if I do it humbly—with a loud noise—to amaze the groundlings? Does the Smithsonian know any elementary microscopy? Where outside of Washington is tomfoolery taught? It is useless. I feel pretty sure—an uncorrected Abbe condenser—has for some time been smarting—but it belongs to the public that buys it. Any scientific nonsense the more absurdly inaccurate the better—the reader will be repaid—the back settlements will be impressed with millions of diameters and all the preposterous results—the other fancy fixings will resolve—a small hole. Won't Abbe Dallinger and Van Hurk be glad to learn about that hole? It is not necessary to disturb these—ubiquitous and irresponsible—gentlemen. Is the editor equally ignorant? Is he a crazy man? It is of little importance. The beads are in the ash-box—according to his dictum. There is no more ardent lover of salutary medicine than—*Pleurosigma pellucida* [sic]. I propose to imitate—I am to all intents and purposes—public property open to criticism—I don't believe the Smithsonian knows that—even the American will eventually turn and—the amateur microscopist—receives scant courtesy from the amateur—half-informed editors. The editors over the sea possess knowledge enough to keep from such absurdities—scientific nonsense—painful nonsense.

Extraordinary manipulative skill—with same nominal focus—would take his objectives apart and hurridily or in any other way—offer such stuff. Where is the leather-medal? It is of little importance—we shall never know. Is there no protection from such balderdash? When was the whole mass of microscopical rubbish set up? Where was the editor when that went into print? Outside of Bedlam—good fun if less sorrow—for incor-

rectly informed contributors. Why is the trusting, unsuspecting subscriber fed with—an explanation, an apology and an antidote. The editor owes him—another fatal defect. How can the same method have another fatal defect? Amplification may be obtained by ludicrously complex means—belittled by their directors. If the stuff were inane only it might be treated with contempt but it is dangerously—microscopical facetiae—not worth the candle.

Here we have it again—he has got the focus—his improved Bardou lens must magnify—that assertion followed to its logical conclusion. It seems a shame. It is a pity. Is it not time to rebel? His blood cell covers a map 600 inches square. It is unfortunate. Could anything be worse? The editor owes him—the explanatory because. It is needed in Washington. There is none in this country. The two—dry mounts—will meet and commiserate—hardly to be wondered at. Nine or seven objects can be supplied which will not easily resolve—after he has done me the honor—too amazing to pass unnoticed. I am—I. Who are you? A crazy man?

Has he never heard of deep eye-piecing? When his—defenseless—extravagant—uproar died away nothing was left but silence—I feel—like marbles in a saucer.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON.

CLEVELAND, OHIO.

PREPARING HARD OBJECTS FOR SECTION CUTTING. — Woods and many hard objects may be easily and readily cut after boiling them. The length of time consumed in boiling depends on the hardness of the object. Some very hard substances require hours. Boiling does not

seem to injure the tissue, at least it does not when the object in view is to obtain a pretty section. For technical histological purposes it is prudent to examine the specimen in its natural state. Some of the planes used by carpenters when in skilful hands will produce elegant thin sections. The suggestion of boiling may, however, prove useful, and be capable of extensive application.

SCIENTIFIC NAMES:—Scientific names constitute an universal language. One may read scientific works in other languages than his own and not have to translate the names of plants or animals. If there have arisen several names for the same object the rule is to select the earliest published. In the Smithsonian report of 1895, page 469, it is said: "There is nothing whatever of an ethical character inherent in a name, which should render it morally obligatory upon any one to accept one name rather than another. The rigid application of the principle involves the assumption that all persons who describe plants are equally competent to the task." Speaking of the change of *Magnolia grandifolia* into *Magnolia foetida*, the author says: "It is difficult to see what is gained by making it, except to render systematic botany ridiculous."

RHIZOSELINIA ERIENSIS. —This diatom is classed under *Appendiculatæ* and is described: Frustule, elongate, subcylindrical, marked with transverse or spiral lines, ends oblique or conical with one or more terminal bristles; marine. To an unscientific person it resembles a butcher's cleaver, sometimes with two handles, one on the upper and one at the lower extremity, and the markings resemble the teeth of two saws, with the teeth of one fitted into the teeth of the other. Though labeled marine it is found abundantly in the fresh waters of the great lakes. It is, never the less, a marine diatom. Its presence in the great glacial lakes is strong proof that the ocean once

beat the shores where the lakes now flow. The diatom is light and frequently floats on the surface.

CETRARIA ISLANDICA.—This is a striking lichen from the fact that the margin of the thallus is beset with pretty little spines. It is found in arctic and mountainous regions. It is commonly known as Iceland moss and the arctic plant is sold in all drug stores. It is generally found in fruit. It has been found in shady glens in Ohio and in New England, but away from its native home in a sterile condition. The fact of its presence in Ohio is a proof of the ancient glacier which once covered a large portion of Northern Ohio and brought this lichen with it to grow as a present monument of the distant past. The color of the plant is olivaceous-chestnut and the disk is dark-chestnut. The spores are simple, small, and colorless. The spinules are interesting as they contain the spermogones.

EDITORIAL.

General Index.—We can still supply copies of the general index (16 years) to this journal to those who have use for them.

Apparatus.—The micromotoscope is a combination of the microscope and the vitascope. It is an invention of Dr. R. S. Watkins, and by its aid bacilli can be unerringly discovered.

Insurance.—At length the insurance companies, which have always made medical examinations of applicants for insurance, have begun to make microscopical examinations of sputum and urine as aids to determining the health conditions of applicants. They have, however, found it difficult to get satisfactory service in this respect from ordinary medical examiners. They can perhaps waive it where the amount of money bet on one's life is small, but

in case of premiums involving \$25,000 they may well employ the best experts. The urinary examination should never be omitted, and each large city can now support one or more microscopists who do this work. In St. Louis, the Paul Paquin laboratories are working up a large practice by advertising and by skillful work.

Opaque Objects.—Prof. Gates has discovered how to view, with a microscope of high power, the upper surface of an opaque object, by means of reflected light, in such a manner as to get details never before obtained by super-stage illumination. He finds by using rays of the shortest possible wave-length that he can focus down into an opaque object upon details beneath the surface. This is especially applicable to organic tissue. It is a discovery of the very greatest possible interest to pathology and biology in general. With lenses out of other substances than glass, he feels sure that he might be able to focus the ultra-violet microscope upon a living cell in the living cortex and take a photomicrograph of such a cell through scalp, skull, pia and dura, and neuroglia. He has been able already to focus upon a capillary beneath the sub-cutaneous tissues of the finger.

Angina.—*Micrococcus tetragenus* has been proven in cases of angina. There were usually manifestations of disease in the pleura preceding the angina. The cultures show it alone or associated with different microbes.

Mosquitoes.—Malarial disease is carried by these agents rather than by winds. It is well-known that people in houses protected by mosquito netting rarely get malaria.

Agar-agar Jelly.—Gallois uses it in skin diseases on account of cleanliness in lieu of lard or vaseline. For erysipelas take 1.5 grain corrosive sublimate, same of tartaric acid, 15 grains of agar-agar, and 3 ounces of water.

RECENT PUBLICATIONS.

Bacteria.—Two books have just been published in German on bacteria; one by Dr. W. Migula and one by Dr. Alfred Fischer, the professor of botany in Leipzig. The former is the first volume of a series, price 12 marks, and contains a general survey of the classification, morphology and development of the schizomycetes. Six plates and exhaustive bibliographies are given. Dr. Fischer's book, price 4 marks, is upon non-pathogenic bacteria, and excludes those met with in medicine. Metabolism, fermentation, nitrification, and the various physical and industrial processes get treated fully. There are chapters on morphology, classification, distribution, habitat, conditions of life, nutrition, and culture, respiration with detailed account of the relation of micro-organisms to nitrogens and carbonic acid.

SCIENCE-GOSSIP.

Faint Rays.—The ordinary leather and wooden walls of a camera allow a certain amount of light to leak through them, and the same is true of the imperfectly fitting sliding joints of the microscopes. All such light which leaks into the camera acts on the sensitive plate without helping to produce the image desired and so as to blur that image. But when the whole train of apparatus is within an actinic-proof box the exposure can be made for hours or days, so that the faint rays of the image can act cumulatively. This makes it possible to expose a plate for a long time without allowing any light to act on the sensitive plate except the light which forms the image.—Gates.

Yellow Fever.—The microbe of yellow fever is alleged to be a fact. Dr. Sanarelli, director of hygiene of Montevideo, who has demonstrated its existence and supplied a remedy for the disease, will probably be entitled to the 150,000 scudi (\$150,000) offered as a reward by the Brazil-

ian Government. He claims also to have discovered a curative serum, and will shortly publish the results of his experiments.

Insoluble Glue.—To render liquid glue insoluble add to it about one-fiftieth of its weight of formalin, stir well, and then expose to strong sunlight for about ten minutes. The action of the light on glue or gelatin so treated is to render it insoluble.

Snake Poison.—In order to confer immunity against the bites of serpents in certain portions of Africa, the patient is inoculated with the poison of the alcatifa, a venomous serpent of east Africa. After the operation the person takes an oath never to kill a venomous serpent.

MISCELLANEOUS.

Wanted.—1-12 to 1-16 immersion objective, 1.30 to 1.40 N. A., adjustable. Address, Dr. Studebaker, Springfield, Ohio.

For Sale.—At London price, a Swift's Bacteriological Microscope, Crookshank pattern, with high angled lenses and Abbe Acromatic Condenser. In perfect order and nearly new. Particulars from A. H. Thomas, M. D., 611 Taylor street, San Francisco, Cal.

For Sale.—A Hartnack microscope in good condition, three oculars and five objectives, including one immersion. Price \$50. Address, W. Adler, care of this Journal.

Slides.—The estate of a deceased physician offers 700 slides for sale at \$10 per hundred. Also, Beck Binocular and six objectives and other accessories worth \$350.—E. E. W.

Exchange.—Arthur Donnelly, Davisville, R. I., wants to exchange a new French microscope, with case, for which he paid \$6, for bird skins or books on taxidermy.

Redondo Beach Diatoms.—One of our Austrian subscribers wants genuine Redondo material, 4 or 5 kilograms,

and no other California earth. Will give in exchange celebrated European and Asiatic material, fossil marine, or if necessary, will pay cash. Address, J. C. Rinnbock, care of Journal.

Wood Sections.—Send to R. B. Hough, Lowville, N. Y., for sample of his sections of wood, 1-1200 inch thick, showing three distinct views of grain under each cover glass.

King's Slides.—We have just received a beautiful collection of slides from J. D. King, Ph. D., of Cottage City, Mass., and think they ought to please the most exacting. Send for his catalogue. Located on the very best part of the Atlantic coast he has unexcelled opportunities to gather marine specimens.

Leidy.—A copy of Fresh-Water Rhizopods of North America, with its 1,190 colored figures, is offered by one of our correspondents in Albion, N. Y., for \$4.25. The book is rare and now hard to get. This is the only copy we know of on sale.

Walter White's Botanical Specimens.—Now we are ready to send complete sets of the beautiful microscopical objects. Please send new orders.

General Index.—If you have not had the general index to the first sixteen volumes of this journal please write immediately for one, and state which volumes you have preserved.

In German.—We have some extra copies of *Zeitschrift für Angewandte Mikroskopie, von G. Marpmann, Leipzig*, to send free to those who wish to see sample copies.

Books.—A subscriber asks about John Phin's publications. Send to the Industrial Publishing Company, 16 Thomas street, New York, for list of Phin's books and other microscopical publications. They are all cheap but not the latest published.

Personal.—Prof. Jeffrey Bell, one of the secretaries of the Royal Microscopical Society is to be succeeded by Dr. Hebb.

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Making Transparent Latern-slides from Marine Specimens.

Mounting in balsam is essential so as to prevent mould, attacks by mites and because they are often too opaque. Some scale off from the glass and break to pieces unless they are mounted. It is wise to mount several, pick out the best and discard the others.

Often the animals are simply arranged on a lantern glass so as to touch it more or less completely all over their under surface, then dry and drain them. Many adhere round the drying edges before the central parts are dry; being thus fixed they do not shrink laterally on further drying but merely become thinner. If they scale off later, gum them down in one or more places lest they become loose when mounted in balsam. There are a few animals that will not adhere to the glass and yet

they shrink greatly so as to render mounting unfeasible.

Small flat fish like soles and dabs, two inches long, mount easily. Kill them in dilute alcohol, arrange on the glass as soon as dead and while limp. Carefully lay out the fins when they will dry and adhere well. Keep the side near the glass flat. As few animals adhere to a thin paper soaked in bees-wax, it can be laid over the animal and pressure applied of a fairly uniform nature upon thick and thin parts. This is best done by using a weight upon a stout glass covered with several thicknesses of fine thin flannel. Regulated so as not to distort the animal but rather to retain the shape and show the internal structures, the specimen will dry through the flannel and keep flat on the glass. Specially high parts can be pressed without flannel and with heavier weight.

Marine worms, like *Sabella*, and others make most excellent transparent slides, which show shape, color and internal structure. Kill them by retaining a short time in dilute alcohol and dry them before decomposition injures the small blood-vessels. In *Nereis*, the chief blood-vessels and the smallest branches may be shown while the even blood keeps its red color for years.

PRIAPULUS.—This form can also be mounted without staining. Kill in fresh water. When the body begins to get limp arrange it neatly on the glass. It will adhere without lateral contraction. If mounted at once or after standing in alcohol, the body is too hard and will not adhere while on drying it contracts laterally producing distortion. To avoid this and to display the internal anatomy, cut the specimen open from end to end and stain with Beale's carmine or Kleinberg's haematoxylin. This brings out the muscular structure of the body-wall and the general internal anatomy.

ARENICOLA.—Cut the animal open and displace the intestine with appendages. Display them on the glass along side of the body. This partial dissection will

show the numerous blood-vessels passing to the lateral branchiæ from the main trunk along the intestine. The color of the blood may remain unchanged for years.

EOLIS.—The beautiful Nudibranchs quickly lose color in alcohol. Hence transfer them after a short stay in dilute alcohol and arrange on the glass to dry. A strong solution of gum is then placed over it and the whole kept damp with dilute alcohol to enable the gum to saturate the specimen and protect the pigment from the balsam in which it is soluble. A bluish tint may disappear at once but the other color remains permanently.

SPIDER CRABS.—These may be kept transparent with their growth of sertularians, sponges and ascidians. Being arranged on the glass, gentle and then stronger pressure is applied, using waxed paper and flannel-covered glass, till the whole is pressed flat without distortion except a slight widening of the body and legs. The leg muscles show well.

MOLLUSCA.—Various species show their general anatomy if we first dissolve away the shell with hydrochloric acid in dilute alcohol. The organic matter of the shell retains a natural form and shows the attachment of the various parts which may be stained or not as preferred. The membranous residue with its form and color left after dissolving away the carbonate of lime makes nice slides.

MEDUSÆ.—Dissolve out all the salt. Keep the specimen in methylic alcohol diluted with half its bulk of fresh water, for some hours. Shake to prevent adhesion to the vessel. Then digest repeatedly with fresh dilute alcohol. Specimens are so colorless and transparent as to show little of their structure but if kept many months in alcohol they turn brown-yellow and show structure quite well. But a far better way is to stain them with tincture of madder, Beale's carmine, methylene-blue, port-wine or tincture of galls. Beale's carmine stains

the canal-system but of an unnaturally bright color. Madder gives a more natural color. Methylene-blue works well with fresh specimens only. A four per cent solution of formic aldehyde is far better than alcohol if the newly caught animals are at once put into it. It will dissolve out the salt. The Medusæ retain their form well. Their delicate parts can be arranged without tearing except that the delicate fringe of Aurelia may prove too rigid to be extended. Having removed the salt and stained the specimen the lantern-slide glass should be put into a developing dish and the animal floated out and arranged under the liquid. The specimen may be half an inch thick in the centre and no attempt should be made to dry it at once since the greater part of the included liquid will diffuse out and be drained off. If the liquid comes off badly spread a solution of gum over the animal. When the edge dries cover it with a strong clear solution of gum to which a little glycerine has been added to make it less brittle. This process is continued till the whole specimen is covered with gum. Keep it then for some days to permit the gum to soak in and the bubbles to disappear by absorption which have not been removed mechanically. If kept in a developing dish over a little water covered by a close-fitting glass plate, a long growth of mould may appear in a single day but if alcohol is substituted for half the water they may remain out for weeks without mould appearing or alteration in the gum taking place which latter would occur in the use of strong alcohol. Do not dry too quickly but anneal the specimen since contraction may cause them to crack and scale off from the glass.

COLORING MATTER.—Dilute sulphurous acid is very useful to destroy the coloring matter, especially in the case of small fishes. If a plaice, 2½ inches long, is kept in alcohol and later in dilute sulphurous acid for a few

weeks, the earthly matter of the bones will all dissolve out and leave the cartilage. The color is reduced and the thickness diminished, but the arteries and their blood are so little altered that when mounted the aorta and branches are well seen over the whole animal.

KEEPING.—When the dried animals have been prepared and it is not desired to mount them at once in Canada balsam, they may be kept in tin boxes with flannel which has been thoroughly dried just before use. The specimens will keep for many months before mould appears.

FINAL MOUNTING.—At the four corners of the glass gum small pieces of blackened card board of such thickness that the cover glass will just clear the object. Keep the glass with the animal for a time in benzole meantime warming the cover-glass on a suitable stand over a small burner and fair quantity of liquid balsam placed in the centre. Take the glass and animal out of the benzole and carefully place over the balsam so as to catch up as few bubbles as possible. The benzole will cause the greater part to bust and disappear. If there is too little balsam, more may easily be run in between the glasses and if there were but few bubbles they will soon go. If too many, slightly incline the slide till they rise to one edge and then remove them. If kept cold for a few days the balsam will harden the edges. Then bind round with thin paper of best quality made thoroughly wet with gum. When dry, the contraction may squeeze out some superfluous balsam. This paper should then be varnished and finally strips of good black paper may be glued well round the whole. Use all possible care to enclose the balsam thoroughly so as to avoid its turning yellow and to prevent leakage when the slide has been heated by the lantern or otherwise. The slides are kept preferably in the dark to prevent possible fading.—H. C. SORBY in *Nature*.

Microscopic Inspection of Pork for Export.

The 1897 Year Book of the Department of Agriculture just published, contains a photograph taken in the room where 60 female meat inspectors are at work each with her instrument before her. Apparently an order was given for every one of them to be looking through the tube at the moment of photographing. The report on the subject is as follows:

In 1881 our pork was prohibited entrance into Germany, France, and the principal countries of the continent of Europe, on the ground that it was infested by trichinæ and was injurious to human health.

Notwithstanding the fact that it could not be shown that our pork had caused disease, and that it was manifestly more wholesome than the European pork, and notwithstanding the most vigorous protests were made by the American Government, the trade was crushed and destroyed. The year before the prohibition went into effect we sold to France 70,000,000 pounds and to Germany 43,000,000 pounds.

For ten years our pork was shut out of nearly every market of continental Europe, when in 1891 the bureau began the microscopic inspection and certification of pork destined to the markets of the prohibiting countries. This action led to the removal of the prohibitions, but the restoration of the trade was a slow and difficult process. Our brands of meat were no longer familiar to the people of those countries, commercial connections had been severed, and requirements as to cuts and cures had materially changed. It was like introducing an article into a country for the first time. Moreover, the prohibition had engendered suspicion as to the wholesomeness of our product, while the agitation had established prejudice and antipathy. There were vexations and burden-

some restrictions by both the general and municipal governments.

Notwithstanding such adverse conditions, the trade with these countries has continued to grow until now it requires more meat than the bureau is able to inspect with the available appropriation. The following table shows the pork which has been microscopically inspected and the quantity which has been sold in the prohibiting countries since this inspection was inaugurated:

Year.	To countries requiring inspection.	To countries not requiring inspection.	Total.
	Pounds.	Pounds.	Pounds.
1892.....	22,025,698	16,127,176	38,152,874
1893.....	8,059,758	12,617,652	20,677,410
1894.....	18,845,119	16,592,818	35,437,937
1895.....	39,355,230	5,739,368	45,094,598
1896.....	21,497,321	1,403,559	22,900,880
1897.....	42,570,572	1,001,783	43,572,355

The difficulties met with in the inauguration of this system of inspection were very serious. There had been no microscopic inspection on a large scale in America, and we had neither the appliances nor trained inspectors. The glass compressors for preparing the specimens of meat and the microscopes used in the German inspection were considered too clumsy and not adapted to accurate or rapid work. An American type of microscope was, therefore, selected. The stage was grooved so that an examination of every part of the specimen was insured and a special form of compressor was adopted which greatly facilitated the work.

The cost of microscopic inspection was estimated before the work was begun all the way from 15 to 50 cents per carcass. The actual cost has been reduced to less than 6 cents per carcass. The packers asserted that it would be impossible to microscopically examine any con-

siderable quantity of pork without delaying their business and damaging the meat. These fears proved to be groundless. The work of the abattoirs has neither been obstructed nor the meat injured. On the contrary, there are now from all points the most urgent appeals for more microscopical inspection.

Cholera, Typhoid and Other Bacterial Diseases Transmitted Through Oysters.

There is no longer doubt that oysters may take up from polluted water various disease germs and that the bacilli will thrive and produce disease in whoever eats these oysters unless the individual eating them is robust enough to resist the multiplication of the bacilli. It is possible for the human organism to be put in such condition that disease will not result even if its seeds are introduced therein, but extremely few are so conditioned; all others should avoid eating oysters unless they know that the the oyster beds have not been subject to contamination. This caution applies not only to raw oysters but in a less degree to stews, since the temperature of the latter is not sufficient to entirely destroy typhoid bacilli. Numerous cases of injury from polluted oysters have now been scientifically investigated.

In 1880, certain people in Scotland suffered from cholera after eating oysters that grew on the copper sheathing of a sunken ship. In this case copper poisoning was transmitted to the consumers by the oysters.

In 1893, cholera attacked two hundred and eighty-seven persons in England, of whom one hundred and thirty-five died. Forty per cent are known to have eaten shell-fish, mostly from the Grimsby and Cleethorpes beds. Cholera had been brought to Grimsby from abroad and the mollusks were so located that they might

have been effected, namely, at the effluent of sewers which contained cholera discharges.

In 1894, twenty-six students, at Middletown, Conn., who had eaten raw oysters from Fair Haven, one week previously, had typhoid and several died. The Fair Haven creek received water from a sewer connected with a house where there were at that time, cases of typhoid.

In 1895, Nature cites a supper at which four friends ate oysters all of whom had typhoid before the end of the month.

In 1894 at Southend, where sewage is deposited near a pier surrounded with oyster beds, a protector of the beds gave oysters to a family August 6th, two members of which developed enteric fever on the 26th and 30th. Some months later he gave oysters to several friends, three of whom had enteric fever.

In 1895, in France, fourteen persons in a small town had eaten raw oysters from Cette and developed typhoid. No other persons than those having eaten oysters were infected and there had been no typhoid in the town for a year.

In 1843, at Marylebone, six persons ate oysters together at a restaurant; all had diarrhoea and other intestinal disturbances, and one of them developed typhoid. The oysters were from Colchester the waters of which receive sewage and other pollution. Quite recently other cases have appeared at Colchester, the evidence proving the cause to be sewage soaked oysters at Brightlingsea.

In 1891, at Harve, France, oysters were eaten from an artificial bed located at the outlet of a drain from a public water-closet which resulted in poisoning. An unusual prevalence of colic diarrhoea and cholera at Dunkirk was traced to oysters from Normandy.

In 1896, in a special report on infectious diseases communicated with shell-fish by Dr. Wood of the Royal

College, it is shown by laboratory experiments, that cholera and typhoid germs in sea water remain virulent and infectious for two months and that shell-fish may be infected.

In 1896, Dr. Klein showed that the typhoid bacilli and colera vibrio retain vitality in sea water. He found the colon bacillus in oysters from polluted beds and absent from those in pure water. He found typhoid in the mangled bodies and liquor of oysters from a sewage laden dock at Great Grimsby.

In 1896 reports of extended researches were made at the British Association for the Advancement of Science. These showed the oyster to have great power of absorbing fecal matter; an increase from ten to seventeen thousand colonies in the bacterial contents of the pallial cavity and of the rectum when the oyster is laid down near the mouth of the drain; more bacteria in the pallial cavity than in the alimentary canal; that the typhoid bacillus does not flourish in sea water without some such nidus as the oyster; that it does not multiply in the stomach or tissues of the oysters; that the colon bacillus is present in very many oysters found on sale; that bacterial infection is largely lost if the oysters are placed in a stream of pure running water.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON.

CLEVELAND, OHIO.

PLANT HAIRS OF PEREANTH OF SHEPHERDIA CANADENSIS.—The backs of the flowers look densely tuberculate. The tubercles consist of plant hairs which readily detach on the slightest pressure and mounted in glycerine jelly make attractive slides. They are

octagonal and ribbed and each segment is bounded by an extended spinulose rib on each side. The outer part is colorless and is gradually colored until a beautiful pink center is reached.

MOUNTING IN GLYCERINE JELLY.—To mount in balsam the object must be free from moisture, but not so with glycerine jelly. To mount in this medium first soak the object for twenty-four hours in a mixture of equal parts of GWA—glycerine, water and alcohol. Remove the specimen from this mixture, place it upon the center of a glass slip and remove the surplus fluid with blotting paper. Place the bottle of jelly in a pail or cup of warm water until it is entirely limpid. It will then remain limpid for a whole evening. With a small spatula take a drop of the limpid jelly from the bottle, cover the specimen and drop enough on the glass slip to fill the space between slip and cover. It is well to mount in a shallow cell and in such case, fill the cell with the jelly. If after the cover glass is placed the mount be full of bubbles discard it. Bubbles may be removed by boiling the jelly upon the slide. In boiling, use a clip and hold the slide over the flame. It will first begin to bubble from the center outward and soon a perceptible crack will be heard. At this moment, quickly withdraw the slide and place it upon a cold surface. Clean it from superfluous jelly with a soft tooth-brush under running water. Then seal with a good cement and ring to suit the taste.

BALSAM MOUNTING.—No more balsam should be used than sufficient to reach to the edges of the cover-glass, and if this point be carefully attended to, the slip will require no clearing preparatory to finishing. Before using the glass slip, thoroughly clean with alcohol. On the center of the glass slip place a tiny drop of balsam, and with a pair of tweezers place the cover-glass over it, and hold over a spirit lamp until a sea of bubbles is seen

underneath. Remove, and with a gentle pressure hold down the cover. The bubbles will all disappear, and the balsam will become hard.

PRESERVING ALGÆ.—To preserve without shrinking use Flemming's weaker solution to kill and fix the specimen (10 c. c. of one per cent Osmic acid, 10 c. c. of one per cent acetic acid, 25 c. c. of one per cent chromic acid and 55 c. c. of distilled water). Its use for from half an hour to twenty-four hours will not injure delicate tissues. Add 10 per cent of glycerine, allowing each drop to diffuse before adding more. This will prevent the shrinking caused by diffusion currents if glycerine is added too rapidly. Add the glycerine until the specimen is well covered, when the fixing solution has evaporated from a watch glass in which they are exposed for the purpose. Red algæ retain their color almost perfectly, but green algæ lose more or less color although the chromatophores retain their shape perfectly and the cells become clearer than fresh material.

EDITORIAL.

Death of Alfred Allen.—Only 6 months ago it was necessary to announce the discontinuance of the Journal of Microscopy and Natural Science of which Mr. Allen was the editor. Following close thereupon comes the report of his death, March 24, at the age of 64. He was long Secretary of the Postal Microscopical Club of England—about 25 years. Thus "microscopists" are falling away and no new men arising to take their places as "microscopists." The users of the instrument are biologists, bacteriologists, doctors, etc.

The Souring of Canned Sweet Corn.—Since 1853 has arisen the corn-canning industry which resulted in 1895 in a pack of 72,000,000 two-pound cans—a total weight of

72,000 tons. Extensive losses by souring have led to careful bacteriological studies. By examining cans it was found that sound cans were sterile and that spoiled ones produced by pure culture twelve different species of bacteria—11 bacilli and one micrococcus. It is believed that they transform the saccharine and starchy matter into organic acids or other substances of disagreeable taste or odor. Sterile cans inoculated with these organisms promptly became sour. A vacuum is not necessary for keeping canned corn for air properly sterilized does not harm the contents. This has been indisputably proven by a long line of experiments. Moreover some bacteria can develop in a vacuum so that the latter is not a sure protection. Sterilization and not air-dissipation is the protection sought. Prescott and Underwood have spent a whole season with the best appliances in canning establishments and have practically settled these difficult questions. They found after extensive labor that heating for 10 minutes to 121 deg. C (250 deg. F) would sterilize corn in two-pound cans. The resistance of bacteria to boiling is such that some survive 5 hours boiling, others survive 8 hours boiling temperature. The ordinary water bath is thus proven useless. By culture methods and microscopical examination it was found that the bacteria were present on the kernels of corn when they came from the field and were in the new cans even after 30 minutes in boiling water and those so found were of the same species as those found in sour corn. Their rate of growth is enormous and appalling. Streak-cultures showed frequently a well-marked growth in 4 to 6 hours. Their multiplication was found to be facilitated by warm, moist weather. The new bacilli discovered require 12 pages of descriptions and the 13 photo-micrographs presented with the paper show plate cultures of the various forms of much interest. The March number of the Technological Quarterly is referred to for further particulars.

Collecting Plankton.—Dr. Dolley has devised a large centrifugal machine which may be driven by hand or by motor. It quickly separates all the suspended matter,

living plants, including bacteria, animals, and inorganic matter in such a way that the result can readily be weighed, the volume determined, the number of particles counted under a microscope, and tables constructed to show the yield of any given area of water. This method is applicable in the artificial propagation of food fishes since it collects the microscopic plants and animals which constitute the food of newly hatched fry. The suitability of water for receiving any fish is as much dependent upon the microscopic food it contains as on its temperature.

Malted Milk Lunch Tablets.—These lozengers are conveniently carried in the pocket and available on trips when one is hungry, faint or exhausted. They contain concentrated food representing the nutritive elements of milk and the cereals. Being free from starch and cane sugar they do not appeal to a disordered appetite. Otherwise they would replace all kinds of candy and ought to do so in spite of that fact. The Horlick Food Co., Racine, Wis., send out sample packages to doctors, teachers and editors free of charge.

SCIENCE-GOSSIP.

Sewage Purification.—At Barking, England, there are biological filter-beds. The measurement of purification attained is taken (a) from the amount of oxygen absorbed; (b) from the amount of albuminoid ammonia got rid of; and (c) the increase in the quantity of nitrates. By passing the sewage intermittently through these filters and by allowing them to rest and become aerated between the charges, it was found that a purification of from 41 to 85 per cent was obtained, the whole of the organic matter was completely removed and an effluent fit to be discharged into rivers was obtained. The purification goes on at the rate of 750,000 gallons per acre of biological filter. At Sutton, England, a little different process is used, the filtrate from one bacteria tank being passed through a sec-

ond, the filtering material being finer grained and the outcome being 80 per cent of purification. The final liquids were free from all odor and remained sweet if kept in open or closed vessels. After the coarse matter was strained out and buried, the subsequent purifications were believed to be due to the work of aerobic organisms.

Micrometer Measurer.—Curtis uses the one described for the quantitative determination of silver. It is simple and can be used with any microscope which has crossed hairs in the tube or eyepiece. It consists of two metallic plates, one above the other, to which a motion parallel to one cross-hair can be given as well as across it. The two are fastened upon a third plate which is attached to the shell of the microscope.

Wood.—Phosphorescence of decaying wood proves due to minute vegetation and is not purely chemical as supposed. The mycelium of a fungus from pine has been cultivated in decoction of beech bark and Agar-agar, the result being a white, brilliantly luminous growth.

Crystals.—Tassin classifies them for microscopic examination under solution, sublimation, fusion. In the first class, they are prepared from solution in a liquid by evaporating and cooling, by reaction of soluble compounds or by chemical changes in general. To secure crystals by fusion prepare a solution in molten magma or slowly cool a homogeneous magma. Crystallization must proceed as slowly as possible and the removal be effected when the solution is at the minimum temperature. Crystals for measurement are quickly and completely dried in order to prevent corrosion or etch figures forming.

Foraminifera.—10,454 fossil forms were found in 1½ oz. of limestone from Cascina, Tuscany. They were so minute as to require 500 to weigh one grain. An ounce of sand from the Antilles was shown to contain 3,840,000 specimens.

Gold Nuggets.—The microscope shows that they have been deposited from a solution around a nucleus. Etched sections show crystallization, often large crystals with in-

clusions of quartz or other impurities but never concentric layers. Fused gold shows a similar structure. Hence native gold has not of necessity been in a melted condition.

Manchester Society.—Papers have recently been read on the slime fungi, Myxomycetes, antenna of a crane fly, on the dissection, preparation and mounting of the radulæ of Hyalinia, and on mounting in glycerine jelly.

Bacteria.—Since 1830, 560 species have become known but only 40 are harmful. Some one says that 250 million could find room on an ordinary postage stamp. We take in 30,000 germs by respiration each day. They are natures' scavengers but they also give flavor to butter, cheese, beer, game, etc.

Zeiss Objective.—His 1-10th inch mono-bromide of naphthalene immersion lens, with numerical aperture 1.60 has resolved or made visible a detail 1-200,000th of an inch in width. This is the highest limit yet reached.

Peat.—Peat originates from sphagnum moss usually, though it may come from heather, lichen or other plants. Its leaves are folded so as to give great capacity for holding water. Under the microscope is found an adaptation for taking up water in the spongy nature of the dead cells lying between the living tissues of the leaf, the internal cavities being connected by canals with the exterior. A sphagnum bog swarms with desmids, diatoms, protozooids and other low forms of life.

Protargol.—This is an antiseptic compound of silver and protein. A one-per-cent solution destroys bacteria of anthrax and enteric fever.

Steel.—With up-to-date micro-photography may be shown the conditions under which the carbon in steel exist. With 1000 diameters magnification, steel may be seen to contain minute particles of true diamond.

Sectioning Bolitic Grains.—A small glass slip is laid on a metal plate over a spirit lamp. Soften a drop of nearly dried balsam upon it with heat, lay a plate of mica on it which will become cemented to the glass. Upon the mica surface embed in balsam and arrange the small objects of

which sections are desired. When the balsam is cold and firm the glass is used as a handle by which to hold the objects while grinding. A flat surface may be given them as they lie in the balsam by rubbing with a hone. Heat the glass to release the mica by softening the lower film of balsam, lift the mica with forceps and turn it over on another glass which has been provided with balsam. The ground surface is now downwards and the other side may be ground as desired.

Protozoa.—A culture medium free from bacteria is made thus: Suspend 30 grammes hay in one litre water, add $1\frac{1}{4}$ grammes powdered calcium hydrate, shake well, heat in oven 24–36 hours, filter, precipitate the calcium with phosphoric acid. Mix the filtrate with equal parts buillon, alkalized with soda. Add $1\frac{1}{4}$ grammes agar.

Phosphorescence.—In case of the limans of Odessa which emit phosphorescent light the phosphorescence is due to an infusorium, glenodinium, whose protoplasm emits the light.

Fish.—Most of their food being microscopical organisms, the multiplication of fish is dependent not so much on the taking and hatching of eggs as on understanding and controlling the food supply; yet the Fish Commissions often hatch and plant eggs in utter ignorance of this phase of the subject.

Archaeological.—Prof. Nicholson of Lewes, England recently found on an ancient bronze implement certain small excrescences which were centres of rapid oxidisation but of recent appearance. He scraped off and examined the material under a 1-4 and 1-7 inch objective discovering that the oxidisation was due to bacteria which swarmed in it. He asks for similar observations and a method of sterilization.

Dust.—A shower of microscopic dust was reported in February off the West coast of Africa and at Leguna, Teneriffe. The dust was grey and extremely fine. It deposited upon every object and rendered the drinking waters salty and colored as by oxide of iron. The sun's

rays became so feeble as to confound the sun with the moon and reminded one of the light of a voltaic arc seen through a frosted glass.

To Stick Paper on Glass.—Make a paste out of 230 parts of mucilage, 20 parts of waters and 2 or 3 parts of aluminum sulphate, dissolving the sulphate in the water before adding the mucilage.

To Remove Tar from Glass.—Make a paste the consistency of cream of pulverized anise seed and extract of licorice. Rub it over the tar thoroughly with the hand, wash with soap and water and dry with a soft rag.

RECENT PUBLICATIONS.

New Book.—General Microbiology is the title Duclaux, of Pasteur Institute, gives to three volumes on the history of ferments, on diastases, poisonous substances, viruses, and fermentation alcoholic and other.

New Atlas.—W. B. Saunders has published an Atlas of Methods of Chemical Investigation by Dr. C. Jakob of Erlangen. It contains 182 colored illustrations (68 plates) and 64 text figures. Price \$3.00.

It takes up clinical microscopy and chemic color reaction, of the blood, as it appears in health and disease, the parasites of the blood, blood spectra and blood crystals, microscopy of the mouth and nasal cavities, microscopy of contents of stomach and intestines, the most important color reactions of the gastric juice, urinary sediments, organic and inorganic, in health and disease; diseases of kidney and bladder, the most important color reactions of the urine, demonstration of some medicaments in the urine, the most important pyogenic micro-organisms, etc.

New Book.—Lehrbuch der Vergleichenden Mikroskopischen Anatomie der Wirbelthiere. Published by Gustav Fischer, Jena, 1897, pp. 681 with plates.

Erythea.—This is a monthly journal of botany, west-American in general, published monthly at Berkeley, Cal. Price \$1.50. Complete sets of back volumes may be obtained.

Bulletin of Buffalo Society of Natural Sciences.—Hand book for students and amateurs in geology and palæontology descriptive of the 18 mile creek near Buffalo, has been issued. It contains 27 full page plates made from photographs of the formations found along this stream. It is by A. W. Grabau of the Massachusetts Institute of Technology and later of Harvard University. It deserves the very highest commendation.

The Society has also issued a review of the North American Delphacibae, a large group of small active insects which at times injure leaves and fruit of economic plants.

Some North American Coniferae.—Prof. E. S. Bastin and Henry Trimble have published a series of papers in the American Journal of Pharmacy and have reprinted them in a pamphlet of 124 pages on the *Pinus strobus* and numerous other pines. They have given especial attention to the microscopic structure and chemical composition. The microscopical structure is described and illustrated by 58 figures consisting of cross-sections of stems, leaves and bark. Their studies have led also to a description of the turpentine industries. The cross-sections have been magnified from 75 to 100 diameters and show nicely the epidermis, hypoderma, stomas, periderm, bast-layer, combium, xylem, lacuna, medullary rays, sclerotic cells, tannin cells, mesophyll cells, phloem, tracheids, transfusion tissues, resin passages, stone cells, mucilage cells, cork formation, crystal cells, and contained crystals.

This publication was intended to be the first of a series dealing with botany, histology, chemistry and economics of the cone bearer, but was interrupted and delayed by the death of Prof. Bastin. Presumably copies of this pamphlet may be obtained from Prof. Trimble of Philadelphia.

rays became so feeble as to confound the moon and reminded one of the light of a candle. Cleveland gave six copies of the book to the school, upon the care of the principal. The book is as to be published by the American Book Co. The book contains many illustrations to know about children, while especially intended for many mothers who are intelligent. Price \$1.25.

ANEQUIS.

A guide for amateurs has been published. Thomas Bolas, the author, has simplified the matter. He is a member of the Missouri Botanical Garden and illustrated beautifully for the American Book Co.

The meeting this year will be at the University of Michigan. The students are going to it.

The death of Prof. Kellicott at the University of Michigan removes one of the more prominent names in the history of the University.

Lessons.—Dr. Louis Reitzmann gives instruction in microscopy, including urinary analysis, histology, pathology, and bacteriology at his laboratory mornings and afternoons. Courses may be commenced any time. Fee \$25.00 for three months, three lessons weekly; or six weeks, six lessons weekly. New York City, 39 West 45th street.

Suspended.—We are sorry to hear that the Journal of the New York Microscopical Society, edited by the Rev. Dr. J. L. Zabriskie at 64 Madison avenue, New York City, has been suspended.

Natural Science News.—Oliver Hotchkiss, Twinsburg, Ohio, offers 60 numbers in general exchange.

Embryo Sissors.—Send 45c for long-shanked fine pointed curved ones to Earnest H. Short, Albion, N. Y.

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Tolles' Monument.

On Tuesday, May 17, 1898, at 3 o'clock p. m., 15 years after his death, friends gathered at Mount Auburn, Boston's noted cemetery, to dedicate the monument that had been recently erected over the grave of Robert B. Tolles. The pedestal is perhaps 18 inches by 36 inches, rising perhaps 9 or 10 inches from the ground. Upon this a large rectangular block of granite is placed, it having about twice the length that it has height or thickness. Upon it is carved the figure of a microscope and the words: "Erected by the New England Association of Opticians to the memory of Robert B. Tolles, 1823-1883."

The monument was paid for by opticians and not by microscopists. In the list of 62 contributors we find, however, the names of W. G. Corthell, H. M. Dunham, R. J. Nunn, M. D. and A. M. Wentworth, who are apparently the only microscopists in the list. The dedication was made by and in the name of the New England Association of Opticians whose committee had solicited the funds. Why it is that the microscopists have so held aloof from honoring the name of Tolles is as mysterious

to us as many of their other doings. We understand that a fund was once started in the American Microscopical Society but that it did not meet with expected encouragement. Why then did not the society put its funds in with those of the opticians in order to make a more creditable monument? Now that the monument is up what will the A. M. S. do with its "Tolles fund?" We have been led to believe that the fund had to be used temporarily to pay a part of the debt which the society was run into by issuing Dr. Seaman's quarterly but if so the fund will be made good presumably after the Society has cleared off its old scores.

But to return to the dedication. An address of President McKenzie was read by Secretary Donovan and an oration of W. Bohne was spoken by Edwin P. Wells. From its sentences the following are of interest: "What is the dredging of the depths of the sea for the purpose of wrenching secrets from nature, what is the scaling of the heights of mountains, what would be the discovery of the poles, what steam power, what even the circling of the globe by electricity in comparison with the journey to the stars which the genius and skill of the optician made possible by the invention of the telescope?"

And what are these inventions and achievements when compared to the microscope, the golden key unlocking priceless treasures, and revealing myriads of worlds never dreamed of even fifty years ago? What was science prior to the advent of the microscope? Take the microscope away and what will science be tomorrow?

The greatest master of the microscope, the man who reached the pinnacle of perfection, whose work was never equalled in any country in the world, was Robert B. Tolles. He stood in the front rank of those whom the world should honor as the greatest of men. But world and gratitude are not synonyms and thus Tolles was suffered to moulder in an unknown grave. Is it not sad

that while the warrior, whose fame is born in the brutal roar of cannon and whose path to glory leads over thousands of mangled corpses and unspeakable sufferings inflicted by him, is honored by monuments, that the genius and toils of such a man who increased the common heritage and the welfare of humanity should be permitted to go unnoticed?

The stake which marks the limit of Tolles' achievements in the construction of microscopes has not been advanced a single inch since Tolles' death; indeed it has never been reached again in spite of the efforts of the opticians of the whole world."

The occasion was utilized by the orator for urging the formation of a National organization of Opticians in order to solidify their efforts and resist the aggressions of the votaries of physics who would reduce the opticians to the level of mere mechanics. It was intimated that ophthalmologists are stealing much of the credit that belongs to working opticians and that the correction of this evil calls for united action in self-defence. The discoveries of astronomy are credited to the users of telescopes and not to the makers of the lenses without which no discoveries could be made. The instrument maker never has been recognized as an important factor in discovery either with the telescope or the microscope. But Tolles' best instrument has never yet found a man competent to utilize its possibilities.

Microscopic Images and Vision.

BY LEWIS WRIGHT.

1. The discussion in the Philosophical Magazine in 1896, by Lord Rayleigh and Dr. Stoney has thrown considerable further light upon a subject which has been discussed for many years; but there seems still something to be added from the point of view of the micro-

scopist, for whom there is at issue in it a very important practical question not solved by any mere mathematical analysis, and scarcely yet, made clear to him. This question is at the bottom of the term "spectrum theory," happily applied by Lord Rayleigh to Prof. Abbe's view of the matter. Upon whatever general method of mathematical resolution the Abbe theory of microscopic vision ultimately rested, it was itself expounded to microscopists and discussed by them for many years as a matter of fact. It was thus and then confined to the statement that microscopical "resolution," or delineation of detail, was due to the union and interference (in the Fresnel manner) at the focal plane, of the direct dioptric beam and of at least one of the beams "diffracted" by minute periodic structure, in the manner of a grating illuminated by light approximating to the character of plane waves: such diffracted beams with white light becoming spectra. The Abbe theory further affirmed that the *trustworthiness* of the microscopical image solely depended upon, and was in direct proportion to, the *number* of orders of these spectra which were grasped by the aperture of the lens; and it explained all the advantages of greater aperture in greater resolution, upon this basis alone.

This was a definite, limited, and practical theory, easily grasped; and this alone was what came to be known as the Diffraction Theory or Abbe Theory. Since, therefore, that term is now applied to the wider manner of regarding microscopic vision which he has set forth, in order to keep things clear or even intelligible to any microscopist who has followed the past discussion, there is really no other course than to find a new name for the more limited and already well known Abbe theory, as Lord Rayleigh has so happily done. The truth or error of this "spectrum" theory, or the respective measure of each in it, is a matter of very great practical importance, as will appear. The wider theory is largely speculative;

but there are obvious points of contact between it and the other, which also have to be considered, and which throw much light upon it.

2. With the purely theoretical bearings of this recent presentment of the case it is not necessary to deal at length. Yet it seems desirable to mention some objections which suggest themselves, and which, if valid, have much bearing on the conclusion of Prof. Abbe, that "diffracted light [defined as "light which advances in other directions than those prescribed by geometrical optics]" is the machinery by which good definition is brought about." That is, of course, getting back to the "spectrum" theory; and this theory is only true in a conditional and limited sense, while its acceptance in a universal sense is a present cause of positive mischief.

3. There are then, some fundamental physical objections to that method of representing what takes place. Putting it most briefly: (A) All light emitted by an object may be resolved into undulations consisting of uniform plane waves. (B) we may conceive these reversed in direction (since any dynamical system may be reversed); and when they thus arrive back at the position occupied by the original object, they will there "produce an image the most perfect that the light emitted is capable of producing." This is held to follow because the plane waves there, as at each step, "reproduce exactly the same state of the ether as had prevailed at the same stations on the outward journey." Hence in general "plane waves converging inwards" are capable of producing the most perfect attainable image producible from the rays grasped by the objective. Stating objections to this with similar generality and brevity, it appears that such a presentment of the matter must break down as a full and complete explanation, however true in a limited sense, on the ground that "uniform plane waves" such as are spoken of, are not in trustworthy microscopy

the actual or veritable dynamical system; and therefore cannot, as it will be shown they do not, produce the supposed most perfect attainable image by reversal.

4. More specifically, it seems evident that we are, *ab initio*, debarred from considering the light from a microscopic object as consisting of uniform plane waves, *except on the condition of plane-wave illumination of the object*. (Here, indeed, we have the secret of Abbe's consistent enforcement of illumination by a small luminous cone or pencil, which gives approximately such illumination). For what are uniform plane waves? A wave-system is normal to the surface called the wave-surface, over which undulations from the same disturbance are in the same phase. Hence the plane wave arises from the Huygenian spherical wave, as a limiting case, in the manner pointed out by all the standard authorities. Thus Lord Rayleigh says: "So long as the radius of curvature [of the spherical wave] is *very long in comparison*, each small part of a wave-surface propagates itself just as an infinite plane wave coincident with the tangent-plane." Bassett puts it similarly—"Spherical waves concentric with the source are propagated throughout the medium; and if the effect which these waves produce at some portion of space whose greatest linear dimension is *small in comparison with its distance from the source*, be observed, the wave may be regarded as approximately plane. We are thus led to study in the first instance plane waves."

The student of physical optics knows that this is so in actual fact. To study plane-wave phenomena, or to verify plane-wave dimensional calculations, he must remove his source of light, itself relatively small, to a considerable distance from his grating or other apparatus; he must get his beams of rays approximately parallel, that the normal wave-surface may be approximately plane. This necessity belongs to the nature of plane waves.

5. But considering now microscopic objectives, many such have been made as short in focus as 1-50 of an inch. It is impossible to regard light emitted from an object, as consisting of uniform plane waves on arriving at the surface of such a lens, after a path of, perhaps, 1-200 of an inch; except in the case of *plane-wave illumination of the object*, as in the Abbe theory.

6. Consider next the supposed dynamical system. This is by hypothesis set up, not by the object alone, or in ordinary method: "We begin by positing repetitions of the objective field." Then it is assumed that all these replicas emit light from their similar points "the same in direction, intensity, phase, and position of transversal." This postulate seems altogether illegitimate in a theory purporting to represent actual phenomena; we know that it is *not* true in physical reality. It, too, depends for the qualified truth which it does possess, upon plane-wave illumination; then it is true, so far as that when approximately plane waves fall upon a grating the width or number of lines does not affect the image of the ruling, as ruling. But it seems to push the result of certain mathematical expressions to an extent which can hardly be justified. The ground of the immense postulate here objected to, lies in the fact that resolution into plane waves of ether-disturbances set up by an object, is represented by expressions which equally represent replicas of the disturbances; the nature of circular functions involving this necessity. Mathematical expressions are but tools, and often have the usual defects of tools; in particular that of not being sharp enough. Ask these functions to express a given disturbance and many surrounding replicas, and they will do it. But ask them next to express an actual limited disturbance resolved in this manner, and no more, and they fail; their edge at present is not sharp enough to do that. Such failure, however, is in this case an imperfection;

and surely to ground such a physical postulate upon the very imperfection of an imperfect tool, is rather arguing in a circle. It seems to be a case of what was described only the other day in a review of a mathematical work, as "the special philosophical vice of the mathematicians, the tendency, namely, to mistake the sign for the thing signified."

7. This seems further to appear, when we consider the *reversal* of the supposed dynamical system. This, it is supposed, produces the "best attainable image which the light emitted by the object [and grasped by the objective] is capable of producing." Unquestionably the light-waves emitted may truly be regarded as a dynamical system; and may be conceived as reversed; and the reversal of the whole actual system would produce such an image as described. But it does not seem to follow that mere "coalescence and interference of *uniform plane waves*" involves such a result. Besides what has already been said as to the absence of plane-wave character in rays from any self-luminous object, at the very minute focal distance of a high-power objective, questions as to the longitudinal components in the disturbances, and their disposal and influence, and several other questions, would seem to need further solution than is known at present, before this could be assumed.

In any case, what the reversal of the supposed dynamical system must really reproduce as an image at the place of its origin, must be the postulated operative cause of the system. That, by the hypothesis, is not an actual object and it alone, emitting luminous waves, but *the object surrounded by an indefinite number of identical replicas, emitting identically similar plane waves*. This does not represent any object in reality: and that fact seems to dispose of such a presentment as a full and complete representation of microscopic vision.

The same conclusion follows from directions "how to see the rulings." We first illuminate the object by a near approximation to plane waves; and then behind the lens further exclude everything but the narrowest pencils of almost exclusively plane waves. Thus we produce a "ruling" extending far beyond the limits of a true image, and which in other respects is as far as possible from being any such. We are really producing, and do produce, easily calculable results of interesting experiments in the interferences of plane waves; and though these results are physically and directly related to the *periodic* structure of the object, considered as an interference-grating, they are no trustworthy representation of it. This truth has always been recognized and insisted upon by Prof. Abbe and his school, resulting in a sort of "counsel of despair" as to any truth or certainty in such microscopical images.

8. This brings us back to the more concrete Abbe "spectrum" theory, as already described. But Prof. Abbe throughout, considers the object to be illuminated by plane waves. In this limited case, what Dr. Stoney advances is more or less true; but Abbe differs from the latter in constantly recognizing that condition and its consequences. Thus, while Dr. Stoney states that a cone of rays from the condenser, as wide as possible, may be used (as in practice it may, for reasons to be seen), Abbe again and again insists that such is not the case, and this at great length. "Strictly similar images," he says, "cannot be expected except with a central illumination with a narrow incident pencil." This is the condition for securing an approximation to plane-wave illumination, with its diffraction phenomena.

9. We may now consider how far the Abbe theory, which possesses more or less undoubted truth, is an adequate representation of microscopic vision; and the most satisfactory feature about the lengthy discussion from

which these remarks originate, is that in several ways additional light is thrown upon that question. The general conclusion at which I have arrived stated briefly as before, is that *the trustworthiness of a microscopic image is in proportion as the object approximates to a self-luminous condition, and diminishes in proportion as it is or has to be (for it may have to be) examined by plane-wave illumination.* This view is of most fundamental and practical importance to microscopy and microscopic optics.

10. Supposing the "spectrum" theory to be true, as a full representation, it was demonstrated that "microscopic vision is *sui generis*."

11. Another fundamental objection to the competence of the theory as a general one, is found in the fact that the character of a grating may be such, that its spectra cannot give a proper image.

12. The object may conceivably be self-luminous; in which case there will be no spectra, and the waves emitted from different points of the object will be quite heterogeneous, and in no permanent phase-relations. Yet an image must be possible, and can in that case be only analysed according to the Airy method. We can only employ a really self-luminous object in experiments with low powers of the microscope—perhaps up to an inch. But even the results with such a power are decisive of the real question; and with high powers we can more or less approximate to this kind of luminosity in several ways.

Thus, even a wide cone from the condenser approximates to it. Lord Rayleigh has shown how and why this kind of illumination must introduce a large amount of heterogeneity into the rays proceeding from the object, and concludes "that the function of the condenser in microscopic practice is to cause the object to behave, at any rate in some degree, as if it were self-luminous, and thus

to obviate the sharply-marked interference-bands which arise when permanent and definite phase-relations are permitted to exist between the radiations which issue from various points of the object." Since Dr. Stoney, however, seems rather to regard the function of the condenser as being that of providing illumination by plane waves, we had better resort to other methods, which may help us to decide what is a very important practical question. For while the ideal is to get absolutely aplanatic systems of plane waves transmitted through the object, and all conditions short of this (caused by imperfections in the slide or various other details) impair the image (as in one special sense they do impair it, with some objects); according to the view expressed, irregularities of phase thus produced may add to the *trustworthiness* of the image, though it may impair it in some other features.

Take therefore as an object on the stage, a grating of 3,000 or 6,000 lines to an inch, illuminated by a narrow cone from the condenser, focussing the flat of a rather distant lamp-flame. Place immediately in front of this flame a coarse grating, 50 to 100 lines per inch, either photographed or of wire. The several points of these luminous lines emit light-waves chiefly in the self-luminous manner, indiscriminate in phases and transversals at the points of the flame itself. Arranging the stage grating so as to cover only half the objective field, a condenser can be selected of such a focal length, and other matters so adjusted, that the focal image of the coarse grating formed by the condenser, corresponds both in intervals and focal plane with the object-grating on the stage, and using the same illuminating cone. Remove now the coarse grating and place the stage grating centrally: then removing the eyepiece and looking down the tube, the dioptric beam and its flanking spectra as so often described will be seen; they are the images of the

source of light. They interfere and form the image seen by the eye-piece, in the Fresnel and Abbe manner. Removing the stage grating, and replacing the coarse one over the flame, its focal image is now the object. Owing to the heterogeneity of the rays, this ærial image emits no spectra—there neither are nor can be any such. But it is perfectly resolved. Here we have a resolution of 3,000 or 6,000 lines per inch that has no place at all in the “spectrum” theory; which therefore can be no *complete* theory of microscopic vision, though it has an important place in it.

Using reduced photographs of perforated zinc, I have similarly used their ærial images in comparison with *P. angulatum* on the stage. Only approximately in one respect, because the difficulty of getting sufficiently reduced photographs prevented use of the same illuminating cone in the two cases. But there is no doubt about the results in all important respects.

As another expedient, we may place beneath the slide a sheet of finely-ground glass. This ground surface refracts and reflects the light in countless phases and directions through the object, the waves issuing therefrom with similar heterogeneity of character. Here also we must have at least a very considerable degree of approximation to the nature of self-luminosity; nor can we get from such illumination any of the well-marked “spectra” or out-of-focus interference-fringes, familiar to us with the Abbe method. The difference in character of illumination by such methods, is so great, that if the “spectrum” theory be completely true, there should at least be a uniform and vast deterioration in the image of an object thus illuminated. On the contrary, with all good lenses of moderate aperture, and slides with any fair amount of opacity in details, such an image is about *the very best we can get*. The excellence of this method of illuminating was first shown many years ago. By its

means really good moderate powers can be used up to their full aperture, rendering the very finest hairs as tapering to a *perfect point*, with entire absence of the diffraction-fringes shown round such details with a narrow pencil. Where and why "resolution" often fails with high powers as regards some objects so illuminated, belongs to the question before us, and is dealt with presently; but the method can be carried much farther than many would suppose. The diatom *P. angulatum* (45,000 to the inch) is resolved by it beautifully with a dry lens; and this self-luminous resolution has the cardinal superiority over Abbe's with a narrow pencil, that by no possibility can any images be produced by it other than the small white disks on dark ground, or black spots on white ground, at different foci, which can be produced in the same way from a sheet of perforated zinc. By grinding the back of the slide itself, even an immersion-lens can be more or less filled with direct rays, and in this way all the spots can be seen (*as spots*, and not falsely as spherules) in *A. Lindheimeri* (69,000 to the inch). With a first-rate apochromatic and one of the slides mounted in sulphate of arsenic, I have seen the striæ in *A. pellucida*; though with such objects as these the method comparatively fails.

13. We may also compare the results of mathematical analysis with those of experiment. We have two kinds of possible image, for the Abbe or "spectrum" image is a real fact enough under the necessary conditions; our inquiry here is simply what *proportion and value* must be assigned to it in ordinary research. Lord Rayleigh's articles here and elsewhere seem to supply useful *criteria* as regards that question. He shows that according to the "spectrum" theory a square and circular aperture of the same width give the same resolution for points or short lines. On the other hand, respecting the resolution of self-luminous lines of sensible length, another

analysis led to the conclusion that a circular aperture must exceed a square aperture by say 10 per cent to give equal resolution. Airy in a slightly different manner calculated that the circular aperture must exceed by about 20 per cent. Experimental test was made using a 50-to-the-inch wire grating in front of a sodium flame, and two different rectangular apertures (with sides parallel to the wires) on the object-glass of a telescope, measuring the distance at which the object-glass (with aperture) resolved the grating. Of circular apertures, four were employed in the same way. The two observers differed very slightly, and the mean for the four circular apertures worked out in the proportions of 1.13, 1.09, 1.09, and 1.09 to 1.0 of rectangular aperture. Here the grating in front of the flame is regarded as self-luminous, just as in the experiment with the microscope above described.

Thus far experiment confirms the analysis; but Dr. Stoney considers (in the previous discussion with me which Lord Rayleigh alludes to) that the same methods cannot be applied to microscopical resolution, on account of the wider angle of the cones of rays concerned, and the physical consequences of that difference. At all events, the agreement of experiment with analysis as regards both kinds of image, in the microscope also, is remarkable.

Calculating by the E line for white light, the ultimate limit of resolution for a dry objective of utmost aperture (N. A. 1.0) is 96,410 lines per inch, which we suppose to be attainable according to the "spectrum" theory, although the aperture is circular. In 1888 Mr. E. M. Nelson, whose microscopic vision is phenomenally keen, just "glimsed" the striæ of *A. pellucida*, mounted in the arsenic medium. Including the double system, or all across the valve, these striæ are about 1-2500 of an inch in length. He used an oil-immersion condenser of

much greater aperture than 1.0, with a single-notched stop, through which sun rays were sent by a heliostat. The beam through the notch being first so oblique as to be outside or excluded by the 1.0 dry aperture of the objective, a strong green spectrum alone appeared at one side of that aperture, at back of the lens. The notch was then gradually deepened until a very small direct or dioptric pencil was just seen on the opposite side of the aperture—replacing the eye-piece. The striæ were just seen. The diatom was probably something less than 95,000 per inch, and any dry lens must be some little less than 1.0 in N. A. Here then, with *very intense* plane-wave illumination—in fact nearly “uniform plane waves”—we have also as nearly as possible the theoretical limit attained, or closely approached, with a circular aperture.

Turning now to the more average kind of microscopic image, the extreme closeness with which Lord Rayleigh's 10 per cent reduction of efficiency in circular apertures represents the facts of observation as found by the most competent observers, will forcibly strike everyone who has studied microscopy for any length of time. But Dr. Mercer, has recently tested the question photographically. It is comparatively easy to prepare circular and square apertures of equal dimensions. He also ruled upon the same glass plate six sets of lines at intervals of 0.42, 0.46, and 0.5 mm. and their doubled intervals of 0.84, 0.92, and 1.0 mm. apart. The apertures were 5.0, 5.5, and 6.0 mm. diameter. It will be seen that both lines and apertures give excesses of about 10 and 20 per cent, representing those calculated by Lord Rayleigh and Airy respectively. An ærial image of these lines focussed by the condenser, was used as the object, and successive photographs taken with all the square and circular apertures. Then only *similarity of resolution* had to be compared, which can be done within very small limits of

observational error. The results agreed with Lord Rayleigh's calculation and experiments, not with the Abbe calculation or with Airy's.

14. Dr. Stouey recognizes essentially what is here maintained. "The standard image is the outcome, partly of the features upon the object, and partly of the state of the light by which the object is illuminated. *It may be improved by increasing the degree in which the first of these factors, and by decreasing the degree in which the second, contributes to produce, to modify, or to efface detail in the image.*" So closely does this practically coincide with my proposition, that had it stood alone or as the final conclusion of his exposition, nothing more would have been necessary; and it has the further merit of recognizing the fact (which constitutes the real place and proportion of the "spectrum" theory in microscopy, and the *nexus* between it and the Airy theory) that we have *two distinct elements* to deal with in an image, whose respective preponderance or proportion are highly variable. The present attempt at further treatment is made chiefly because he does not seem to recognize the true relative proportions, either in maintaining with Abbe in such a universal sense that "diffracted light is the machinery by which good definition is brought about;" or "the great assistance which is rendered to the practical microscopist by Abbe's theory."

(To be Continued.)

Woods.—L. W. Hahn, Silver Creek, N. Y., offers 110 varieties of foreign and native woods for \$3.00.

PERSONAL.—Prof. W. A. Rogers died at Waterville, Maine, March 1, 1898, aged 61 years. He had been professor of physics and astronomy in Colby University since 1886 but expected to remove to Alfred University the present spring.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON.

CLEVELAND, OHIO.

TRICHIA.—On a piece of bark, from the woods, a golden yellow dust was found. Examination with the microscope developed that this dust was entirely composed of the threads and spores of trichia. By placing a very small portion of the yellow dust in water on a glass slip, then teasing with needles and mounting in glycerine jelly a very acceptable instructive slide was produced. A good picture of these threads and spores is given on page 32 of "Fungi" by M. C. Cooke in volume XX of the International Scientific Series. The plant, however, is not a fungus but a Myxomycete belonging to the lowest order of plants the Protophyta. It is described in Bessy's Botany on page 211 where trichia is placed in Order VII, Calonemææ.

A LITTLE LEARNING IS A DANGEROUS THING.—So is a tyro in microscopy who poses, in court, as an expert. So is a microscopical expert in one department who poses as an expert in another department. So is an expert who for a fee under the guise of being an expert acts as an attorney for one of the parties to a suit. The disagreements and contradictions of microscopists in court is disgraceful. A fixed set of stupid questions are permitted and the scientifically stupid attorney on the other side is generally too obtuse to cross examine so as to elicit the whole truth.

THE EXAMINATION OF WATER.—Fail not in examining water to examine the specimens on the surface, in the sediment and those suspended. In each stratum a different fauna and flora will usually be found. To see bacteria and very minute specimens resort must be had to other means.

MICROSCOPICAL AQUARIA.—For study and the enter-

tainment of one's friends two simple aquaria will be found convenient. First, for vinegar eels, pour into a wide-mouthed bottle some pure cider vinegar already infested with the *anguilullæ*; to this add a spoonful of boiled starch; watch the bottle from time to time and add vinegar to supply evaporation. Fungus may form on the top. Touch this to a glass slip, remove the fungus, cover the slide and examine. A great sight of hundreds of writhing eels will be displayed.

FILTERINGS OF THE WATER SUPPLY.—Pour the filterings into a conical glass or beaker. Re-enforce the supply with new filterings, at least once a week. One may thus keep a supply on hand for years. The glass or beaker will have a deep sediment of diatoms and desmids which will furnish food and oxygen to the animals in the super-natant water. Here one may study the survival of the fittest as one set of prevailing infusoria disappear and will be superseded by another. The starch diet will fatten the vinegar eels and render them easy for manipulation. An inch objective with a C or D eye-piece will exhibit the *anguillulæ* to good advantage.

SCIENCE-GOSSIP.

Medical Microscopy.—The chief medical officer of the U. S. army says: While scientific medicine could not exist independently of the fundamental branches, they simply constitute the basis upon which the superstructure has been reared, to a large extent during the last half of the present century. The histological changes which occur as a result of various disease processes, were unknown and unknowable in advance of the invention of the compound microscope, and the same is true as regards the ætiology of infectious diseases. The discovery of the anthrax bacillus (1850) and the demonstration of its ætiolog-

ical relation to the disease with which it is associated, by Davaine, Pasteur, Koch, and others (1863-1875); the discovery of the tubercle bacillus by Koch (1882) and the discovery of the malarial parasite by Laveran (1879)—these discoveries, so essential to the progress of scientific medicine, would evidently have been impossible without the aid of the compound microscope. While we owe much to the methods of research devised by Pasteur, Koch, and other pioneers in this line of investigation in the application of these methods, the compound microscope is absolutely indispensable, and, as medicine could not profess to be scientific so long as we were ignorant as to the ætiology of disease and of the histologic changes resulting from disease processes, we must recognize the perfection of the compound microscope as the most important event of the century from our present point of view. The principle involved in the construction of the compound microscope was invented as long ago as in the sixteenth century, but it is only within the present century, and principally during the last half of the century, that those improvements have been made which have made it available for ætiological and histological studies. There is, however, a growing disposition to suspect that our microscopes, notwithstanding the great degree of perfection attained in their construction, are still inadequate to the task of revealing to us the specific infectious agents of certain diseases, because of their minute size.

Gates' Double Microscope. This has been repeatedly done before, and as often condemned. A second microscope forms a most inefficient eye-piece. With regard to deep eye-piecing, a 20-power eye-piece will easily render visible, even to one possessed of ordinary vision, everything that a $\frac{1}{4}$ inch objective of N. A. 1.0 (oil immersion if you like) is capable of resolving. EDWARD M. NELSON.

War.—On September 18, 1870, mail communication from Paris was interrupted by the German investment of the city. Balloons were at once resorted to and on Sept. 23, 25,000 letters were carried out by the "Neptune." Later

1,200 went out on the "Washington." While letters could be carried out they could not be brought in by balloon. Carrier pigeons were therefore sent out with the balloons and permitted to bring back dispatches. These had to be light enough in weight for the pigeons to carry. Photo-micrography was therefore resorted to. Messages were copied on a single sheet of paper and then reduced to the most minute proportions. On their arrival in Paris the characters were enlarged by the microscope. Each message was then copied on a card and forwarded to the person addressed. Each word cost ten cents and each message was limited to twenty words. Later the messages were printed from type and reduced still farther. They were put on pieces of paper $1\frac{1}{4}$ by $1\frac{1}{2}$ inches. The collodion films were rolled and enclosed in small quills which were sewed to the tail feathers of the pigeons. The collodion films were ten times thinner and lighter than paper. On arrival, in Paris, the quills were split open and the films rapidly unrolled in water containing a few drops of ammonia. The films were then dried and enclosed within two plates of glass. They were then ready to be deciphered by the microscope. This mode of reading was later supplanted by a projecting lantern and electric light. When thrown upon a large screen four transcribers could work at once on each sheet contained 1,600 messages. At a later time, the films were photographed back to the scale of the original printed matter so that each section was enlarged from the most minute dimensions to a form that could be read with perfect ease. Then the telegrams were separated by scissors and each person received a dispatch in fac-simile to the original printed matter. Many of these dispatches are today exhibited as specimens of photomicrography.

Milk.—In Dr. Julius Nelson's investigation it was found that milk in a cow's udder may have as high as 10,000 bacteria per drop, that first drawn being most infected.

Wanted:—Petrological microscope with accessories for petrological work, instrument to be of superior grade and in good condition. Send description and price.

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Microscopic Images and Vision.

By LEWIS WRIGHT.

(Concluded from Page 104.)

15. We therefore next consider that illustration. To begin with, the resolution of *A. pellucida* is no real problem at all: it is not even of the same nature as the problems which do confront the scientific worker. Supposing it were, the latter would regard with consternation the elaborate apparatus described for producing monochromatic light. This diatom, however, has been studied for many years; the dimensions of its structure are known and familiar; and the powers of annular illumination have long since been ascertained. It is no problem, or one in which help is needed, to take what is really a "grating" of this *known* fineness, and already *known* to have this definite periodicity of structure, and arrange matters so as to get the most conspicuous "resolution" of it. The problems in which assistance is really wanted, the microscopic worker's really "difficult" objects, are such as Dr. Dallinger confronted

in detecting the spores of a monad, itself only 1-6000 of an inch in diameter and themselves only 1-240000 of an inch ; or more especially (because here was involved real "resolution" of fine detail) the *process of division* in the nucleus of a cell, itself only 1-20000 of an inch long. In such cases what will be found and is to be observed is *unknown* ; accurate periodicity of structure is probably absent ; and mere artificial force of clearness in "resolution," even if obtainable (which it seldom is) is worthless in comparison with known trustworthiness in the image so far as it goes. Taking any such case as this for our test-object, and comparing it with the treatment of the *A. pellucida* as described, we shall be able to appreciate the proportion of both truth and error—for there is truth as well as error—in the "spectrum" theory.

16. We cannot help, in the first place, seeing much error. While the minuteness of structure to be detected by Dr. Dallinger (in an unknown object) was as great, the method of proceeding described for the *A. pellucida* is impracticable, and would be useless even if practicable, real work has to be done by far different means. The finest lenses, used with a wide and solid aplanatic cone of light, could alone do such work ; and moreover, earlier lenses of 1.48 N. A. were surpassed in results by apochromatic lenses of 1.40 N. A., better corrected for spherical aberration—the meaning of which we shall see. Supposing the microscopist, however, to know or suppose the measure of minuteness in the divisions of the cell-nucleus, he would, have to employ (with doubtless some modification in detail) arrangements for *plane-wave illumination* generically similar to those he describes for the diatom. But he would be wrong, and the results would be *nil*.

Narrow pencils and annuli have of course been tried, for the contrast they give. The probable reason of failure is want of sufficiently regular *periodicity* in the detail. Only such periodic detail is shown better by

such methods ; all else is "blurred." Dr. Dallinger had to do such work with a high degree of heterogeneous illumination—as close an approach as is possible with the lens used, to a self-luminous condition of the object.

The image even of the diatom is a false image. It is admittedly so in regard to the "spherules," and competent judges are very doubtful whether even the breaking up of the striæ so shown, is not due to false diffraction-fringes from the midrib of the valve, the spherules being thus arranged in longitudinal rows far more straight than is really the case. Looking at the matter theoretically, it will be observed that after having laid down how the excellence of the image is in inverse proportion to "the degree in which [the state of the light by which the object is illuminated] contributes to produce, to modify, or to efface detail," he proceeds to obtain this image by almost the greatest specialization of the light which is possible. The effect of this is to replace the actual detail, by other apparent detail which is visually intense, and geometrically symmetrical, to an utterly false degree.

Similar results are traceable in other diatom work by the Abbe school, as may be shown by the most familiar test-valve of all, a much coarser one, the *P. angulatum*. Dr. Van Heurck has photographed this with the celebrated Abbe-Zeiss lens of 1.63 aperture and dense immersion-fluid and medium, by Abbe methods, with an uncorrected condenser; the result is a series of hexagons resembling a honey-comb. Dry objectives can only image details "correctly so far as regards their number and position, but any further detail is not correctly represented." Immersions embracing most of the first spectra, "we now see some detail: the dots appear hexagonal, and are separated from one another by walls which are thin, and which look like a honey-comb;" and "this is the first and only step we can take towards

learning what the actual detail is," because no objective will embrace the other orders. Examining these several statements, there is every reason to believe that a dry objective with a wide cone of light gives a perfectly truthful image, while it will give the hexagons quite easily if that figure is preferred; Zeiss's well-known large-scale photograph is of a value so coarse that it is beyond dispute that a portion of the second-order spectra *were* included by the lens used, with the result of introducing a false *doubled* resolution impossible with first orders alone; and an immense further step can be taken by using a first-rate immersion-lens of 1.40 aperture, with a wide cone. The Zeiss photograph $\times 4900$, and the Van Heurck photograph, are confessedly the highest triumphs of photography by the Abbe method: one has only to compare both with the beautiful photograph $\times 4900$ taken in this other way by Mr. E. M. Nelson, and other similar ones up to a scale of $\times 6400$, to see once for all, which is the truest image, and the all-importance of a sufficiency of heterogeneous light.

The minute detail in some of these photographs could not possibly be shown by that method, because, minute as they are, they are *unsymmetrical* and not *periodic*. In regard to the *P. angulatum*, both circular disks and hexagons can be seen, depending upon the precise focus; the sharpest portions show the circles, which, disposed in quincunx arrangement, most diatomists who have worked with English appliances believe to be the true figure. Besides the sharpest image, we have the phenomena of "postage-stamp fracture," and the shape of far coarser markings in other diatoms to guide us. Mr. C. Haughton Gill has demonstrated that the spots are either apertures or depressions, by depositing pigment in them; and the various images can be imitated with perforated zinc. It is the distinct outlines of the *fractures*, and broken-through apertures, which are so

magnificently shown in Mr. Nelson's photograph with a wide cone.

17. We can also, however, see the large amount of *truth* in the Abbe theory, and its important, though not *all-important*, place in microscopic vision, especially for certain classes of objects. Wherever we have a known periodic structure in transparent objects, plane-wave illumination and the consequent interference-lines formed by the beams diffracted by that structure, have an extraordinary effect in *intensifying* into black and white a more or less accurate representation of the periodic detail. How this occurs can be easily seen from two examples, macroscopic and microscopic.

Take first quite a coarse striation of 50 to the inch, visible to the naked eye, represented by a grating of platinum wire and by a piece of platinum foil corrugated to the same gauge. Make the wire incandescent, and (checking irradiation by a smoked glass) the striation is easily seen. Make the corrugated foil incandescent (these observations are supposed to be in the dark) and probably the detail will be quite invisible. The eye was quite competent to see structure of this fineness by the Airy self-luminous method, if the detail was in contrast; but there is now no *contrast*, and the detail is more or less invisible. Then let the corrugated foil be cold and illuminated by extraneous light, and the detail is seen again. There is both *shadow* to assist the contrasts, and also there are phase-relations between the tops and bottoms of the striations which come into play.

Let us further imagine a perfectly transparent structure with uniform periodic detail, but the elements of that detail differing in thickness only; and let it be mounted in a medium of nearly the same refractive index. A diatom in balsam nearly represents such a case. It is quite evident that by heterogeneous illumination at all approaching the self-luminous character, it

will be difficult to find anything *sufficiently contrasted* in detail to see at all, though the very same illumination of a *black-and-white* photograph of small scale, or of the same diatom in a medium of 2.4 index, might show it easily. But plane-wave illumination might very easily bring about phase relations more or less approximating to *half-wave discordance*, which we know well would be more effective than black-and-white itself by direct light; in any case these phase-relations will produce conspicuous effect in a Fresnel-fringe image. Thus the Abbe method has a most important function in enabling us to see *contrast* in the details of a large class of objects—especially hyaline or transparent objects—which do not present contrast or opacity sufficient to be seen in any other way. The error has been in giving to it the sole or all-important place, not recognizing that there is quite another kind of image also available, depending upon Airy's theory; and that this latter, while in the the case of transparent details often giving images insufficient, or at least far inferior, in black-and-white contrast (what microscopists call "resolution"), is free from the *contour* errors of the Abbe image, and must be used to correct it so far as is possible in the individual cases.

The errors of the "spectrum" image are well known: Prof. Abbe himself has sufficiently insisted upon them. Its very contrast, or "resolution," is in most cases a glaring departure from *truth*, to which (when we can get resolution at all) the more indistinct self-luminous image is in reality a far nearer approach. It tends to make details which should be only geometrically symmetrical to a limited extent, perfectly so. In extreme forms it makes rows of spots into lines, and these lines straight when not really so. It is always liable to false resolutions of double fineness. It fails to give even a tolerable image of the larger features of the object, thereby showing its failure to be a real "image" at all. All

that can really be learnt from it, is that there is probably (for this is subject to possible delusion from the false intercostals above mentioned) *some* periodic difference of structure in the object *similar in dimensional intervals* to "lines" shown: in regard to "spots" this is more uncertain, since these are often produced by false diffraction-fringes from any long line which may cross the true ones. That the lines are lines, or that the "pattern" is so geometrical as appears, is in the highest degree improbable. That the "spectrum" theory and method so long retained exclusive predominance, is because attention has been so concentrated upon either gratings or diatoms of *known periodicity* in structure, but which only represent to a very small extent indeed any serious kind of investigation.

18. It appears that in microscopy we have to deal with two characteristics of an image, which often are only to a limited extent compatible; that we have at command two methods of illumination which respectively promote more especially each of such characteristics; and that in most cases our problem is so to combine and balance these two methods as to produce the best result. *Fidelity of contour* will be secured in proportion as we are able to obtain our image by heterogeneous illumination, approximating the object to a self-luminous condition. But this method may prove utterly unable to give us *contrast*, which we may therefore be compelled to increase by using to a greater or less (even to a very large) extent plane-wave illumination, at the expense, however, of some greater or less degree of infidelity in contour. Thus an opaque subject, even of much minuteness, may be best shown by ground-glass illumination, or a very wide cone; while a diatom, unless in a very dense medium, or dry in air, may require narrow pencils of approximately plane waves. It is interesting to observe that there is thus a great degree of practical truth in

Prof. Abbe's early contention as to "different origins" of different parts of the image. Many of us have written of this as an "error," now "recanted," which strictly is true; but there is this broad practical sense in which it also is true.

And we are unable to use either kind of image or of illumination absolutely pure, if we desired to do so. The narrowest pencil we can practically use will not give us absolutely plane waves alone; there will be some amount of heterogeneity in the pencil, which in some little degree serves to *correct* our image. And the widest cones we can use, or even ground glass, do not prevent greater or less approach to the character of plane-waves, as the rays travel farther from the lamp; and these by their interference tend to *intensify* the image. We have to play off and adjust one against the other. In so far as we may regard every elementary or excessively small cone or pencil of rays from the condenser as an individual beam of plane waves (which no doubt is the case in some degree), in passing through the object it originates two or more pencils from the same point. These being necessarily in the same phase or phase-relation, so far as they exist must interfere at the focus, and thus *intensify* the image. On the other hand, the numerous such elementary pencils comprising a wide cone, are in many discordant phases and transversals, and this very heterogeneity tends to correct the *contours* in the image, as above. We thus understand why, in really critical work, a large cone from a good condenser usually gives us the best results; but why it may be impossible, even with a perfect objective, to use a cone of light which will fill its aperture completely. It may be necessary, to intensify the image, while using as much heterogeneous light as we can, to use only pencils each of which throws out another diffracted pencil grasped by the aperture, so as to intensify, or correct it. But this

necessity depends on the nature of the object, and does not exist in all cases.

19. There is a very obvious and simple, yet decisive test as to the correctness of this view. According to the Abbe or spectrum theory, the amount of cone or heterogeneous light which can be used will depend upon the *minuteness* of the structure alone. According to the view here maintained (which recognizes the Airy theory as also concerned in the image) the *density or contrast* of the structure is the chief factor in this question. All experience proves that the latter is the case.

It only remains to show how directly the questions here discussed affect practical microscopy and the work of the microscope optician, and also determine the prospect of further advances in our powers of microscopical research.

20. The Abbe or "spectrum" theory has in its time, confessedly, led to enormous improvements in objectives. Owing to that specialization and ignorance of what physicists had done, there was amongst microscopists no understanding of the direct function of aperture in resolution; and so the Abbe theory was for years written about, and advanced as "the first explanation ever given." It thus produced a vivid consciousness of that function which was entirely new, to which we owe our present immersion and other high aperture lenses. But it is as easy to show that, this work being done, its undue preponderance and acceptance as the *only* theory, especially on the Continent, is now causing distinct prejudicial results, owing chiefly to its connexion in practice with a narrow pencil or cone. Abbe himself throughout insisted upon the narrow pencil. Dr. Van Heurck does the same; Dr. Peragallo writes that a cone of more than 0.50 N A. is of no use; and Dr. Dallinger, and authorities like him, who in a general way accept the Abbe theory as *the* "theory," but know from their own exper-

ience the vital necessity in difficult research of a wide cone, write expressly of "theory and practice being thus at variance," in some way or other which had to be explained.

It is difficult to estimate the prejudicial effect of this upon microscopy on the Continent. As a quite uncorrected condenser will give a fair cone up to 0.50 N. A., and also by immersion extremely oblique rays from its margin (equivalent to annular marginal illumination), for years no better Continental condenser was made. Prof. Abbe at last was driven to compute an achromatic, but this last production of Continental microscopy only gives an aplanatic cone of 0.65. Except those few who know of English condensers, with their *aplanatic* cones of 1.10 for immersion and 0.90 for dry combinations Continental workers have thus been condemned to the errors and weaknesses of narrow pencils, which have thence been propagated through our own medical schools and the results are sufficiently striking. Dr. Koch at last found out, empirically, that wide cones gave much sharper and "finer" images of bacteria, in fact the only images worth having. Prof. Abbe accounted for this observational fact, in an article expressly contradicting any advantage whatever to the image (as an image) from a wide cone, on the ground that the wide cone, owing to its more sharply defined focal plane (want of "penetration"), makes invisible the transparent tissues in which the bacteria are situate. But he fails to account for the fact that it is just the same with bacteria in invisible culture-media or sputum; and that the advantage really consists in the much greater sharpness or *thinness* of the images of the bacteria themselves; in truth of contour, so that square ends are shown square and not rounded; and in the fact that there are no blurred edges or diffraction-fringes around them, as appear with a narrow cone. In fact, many allied bacteria cannot be distinguished at all

by the microscopic methods still too current in our schools, which have taken their methods from Germany.

At the Jena workshop in 1895, Prof. Zimmermann, one of the scientific staff (who has himself published a work on microscopy), said that in photographing they found no difference in results obtained by the chromatic and achromatic condensers; which is equivalent to the statement that they knew of no better results than those from a 0.50 cone. Our results are quite different. Mr. A. Pringle, whose splendid photographic work on bacteria is well known, often uses the largest aplanatic cones; and, Dallinger: "Photo-micrography with a small cone is quite easy, as great contrast can be secured [the reason has been shown in foregoing paragraphs]. With a large cone difficulties begin—difficulties of adjustment, difficulties of lens correction, difficulties of exposure, and difficulties of development. If, so far as our experience goes, a good photo-micrograph is required, these difficulties must be mastered."

21. This quotation leads us to the prejudicial effect of the theory (or rather of its undue preponderance) upon microscopic objectives. The mode of illumination directly influences the quality of the objective; because the all-important point of correction for spherical aberration has commanding influence upon the cone of heterogeneous rays which can be used with it. This does not appear under the Abbe method; and Strahl maintains that "the influence of spherical aberration has been considerably over-rated in objectives!" The most eminent firm of Continental opticians states that its lenses, owing to the system of calculation and manufacture, are uniformly free from spherical aberration, so much so that there is no need for any "empirical tests," viz., testing upon the microscope itself. That is not the case when tested by the more perfect English appliances. The condenser itself is an English appliance. Ten years ago only one house,

I think, made one with wide aplanatic cone. Today every English house of any standing constructs achromatic combinations with 0.90 of aplanatic cone, and two construct apochromatics. Not long ago, having the opportunity of testing and comparing three similar objectives together, I was enabled to see the difference. With the Abbe condenser there was no very obvious distinction; but tested by English condensers it was quite otherwise. The great firm had no cause to blush for any one of them; all were good lenses; but they now revealed as distinct characteristic features as one sees in individual faces. On a graduated series of *Poduras*, one of them now gave most unusually good definition with rather a small cone under the highest ($\times 27$) eyepiece; while a second, scarcely equal in this point, excelled the others in the *wide* cone it was able to use on this object. Another operator more skillful than myself, and certainly of keener vision quite independently reached identical conclusions. Slight variations of pressure in the final polishing of the glasses are quite sufficient to produce such differences as these, in such small lenses as are here in question.

Whether this latter be the cause, or some other, nearly all high power objectives even of the present day, and of the very best makers, show a very sensible amount of aberration. Drawing a circle to represent the whole aperture, and smaller concentric circles to define zones of its surface, many of the zones have *slightly different foci*. This fact plays all sorts of insidious hanky-panky-tricks with small-cone interference images of the Abbe kind; giving more force to such of the spectra as are correctly focussed than to the others. But in other respects, with small cones, these zonal differences are not obvious, and often escape detection, many portions of the aperture not being utilized at all. There are refined tests familiar to opticians, and some

others employed by highly skilled microscopists; but not only are these too seldom employed by even the best makers before the lens is sent forth, but we have seen that even their necessity is disputed, and the importance of spherical aberration itself actually challenged, by adherents of the "spectrum" theory as heretofore understood.

When, however, we do employ adequate tests, and at the same time make careful comparisons between one objective and another, we find that the perfect correction of spherical aberrations is just *all-important* in determining how far we can go in using with that lens the heterogeneous illuminating cone which is so important for depicting true contours in our image, still preserving sufficient resolution of minute structure. (We are here postulating sufficient opacity in the details, to dispense with much of the aid we have seen to be often necessary in hyaline subjects.) High-class moderate powers now easily utilize their full aperture, with ground-glass illumination. With high powers, the amount of this, or of aplanatic cone possible, is in almost direct proportion to the perfection of spherical correction. Few lenses over 0.60 N.A. will, however, even yet bear more than three-fourths of their aperture as direct light; many very good ones only two-thirds. And objectives differ strangely. In Zeiss's apochromatic series, the half-inch of 0.65 N.A. and the $\frac{1}{2}$ immersion of 1.40 stand out from the rest: some rare specimens of the former will bear their full cone, and occasionally an $\frac{1}{2}$ of 1.40 has been used in photography with a cone of 1.10. Very recently there was sent me for examination by Messrs Swift, a new English 1-12 apochromatic of 1.40, which was remarkably well corrected spherically. A rough but very fair idea of the spherical correction may be obtained almost immediately by focussing a *Podura* test-scale with small cone and then ascertaining how far the iris can be opened without

altering the image of the exclamation-marks. Using successively larger *annuli* of light, this test becomes far more efficient and severe. It was accordingly tested upon *A. pellucida* mounted in arsenic by Dr. Van Heurck. All the transverse striæ in the diatom were most easily resolved with a central, solid, unstopped full aplanatic cone of over 0.90 from a dry condenser. The larger features were of course also quite correctly and sharply imaged.

But this is not nearly the limit. Owing to some astigmatism and other defects, my vision is very coarse and imperfect in these matters, and for me to see the striæ means much more for many other observers. The first valve Mr. E. M. Nelson showed me in balsam as "strongly" resolved, was to my sight quite unresolvable, and he had to search for another, which I was able to see. This diatom is one of the most variable in resolvability of the whole list, quite apart from the mere coarseness of striation. *That* is no difficulty at all. Since that experiment Mr. E. M. Nelson has shown *A. pellucida* clearly resolved into striæ *mounted in balsam*, as well as "dry," with a similar cone of over 0.90 from Powell's apochromatic condenser, and a Zeiss $\frac{1}{2}$ apochromatic of 1.40. This latter lens was probably one of the finest ever made, and the mere striæ were not all it had to tell us, using no arrangements beyond the 0.90 full cone, and Giffard's green light-filter. On a dry valve, it clearly displayed where bits of coarser upper membrane with their blacker lines were overlying the lower, as is more often seen in *A. Lindheimerii*. And on a strong valve in quinidine, carefully adjusting for what may be termed the "white" focus, each of the striæ could be seen outlined at both edges, the outlines being a series of small convex curves, scalloping out the stria into partly-defined oval beads. The divisions or narrower necks between these partly-defined ovals did not lie in longitudinal rows, but occurred with a considerable degree of irregularity. Such

resolution, which most closely parallels the coarser *Lindheimerii* valve, may be the truest resolution yet attained.

No doubt the above lens was an almost phenomenal one. Every practical microscopist knows that the "similar" objectives, by even the very best makers, are not "all alike," whatever the makers may affirm. They differ in features as in a case above mentioned; most of all in the cone they can employ in critical work, and in what such a cone will reveal. Everyone engaged in difficult research has some favorite objective, treasured and spared in work as much as possible; because he knows full well that if parted with or injured, though he can buy a "similar" one at the list price, it may be long ere he finds such another.

22. The question of how far we may still expect advances in our optical powers of research is important; and it is answered very differently according to the "spectrum" theory, or the qualified views here maintained. It not only follows from the foregoing, but has been over and over again stated expressly by the Abbe school, that we have no hope of further advance, except through increase of aperture; and on that ground was constructed the lens of 1.63 N.A. to be used with flint-glass mounts and dense fluid media—conditions under which it is practically useless. So little are other conditions recognized, that Dr. Van Heurck has only used the chromatic condenser in his skillful published diatom photographs; and those results are simply *nil*, not one of them surpassing, or in some respects even equalling, what has been done in England with 1.40 lenses.

It is far different if the Abbe theory be relegated to its proper place and proportion. Then such "lucky" objectives as the above assume a very marked significance, and hold out a world of promise: in them and in what they tell us lies the future of microscopy. Not the best even of them is probably *perfectly* corrected for all its

zones; but the best of them reveal a marvellous standard of approach to this; and with that we find ever associated an increase of that practicable cone of heterogeneous light which we have found so all-important to true contours. *And with this we get further revelation.* More minuteness we do not indeed get; for that we can look only to the 1.63 lens. But we have a world of structure to learn yet, *within the resolution* of our present lenses; and for that we are only waiting better condensers and better correction. It was only recently that the protoplasm so long written about as "structureless jelly," yielded up some at least of its marvellous and minute structure, which can only be seen by English wide-cone methods, with one of the exceptionally-perfect objectives here referred to; whose significance, however, as we have seen, is not yet recognized on the Continent as it is in England, and even here only by the few. It may be beyond us to-day to discover the minute departures from type which cause the superiority of the few phenomenal lenses: it is no easy thing to ascertain precisely what it is, in a lens one of whose components may not exceed a hemisphere 1-16 of an inch in diameter. But the superiority is there; it has been attained; and we may cherish reasonable hopes of such discovery. We may anticipate that the present rarest excellence may be reached yet as a standard, more generally procurable by the scientific investigator; that the very best of all may even be further improved in correction in some degree. If it be so, such advances will not be barren of results in research. The microscopist may yet hope and take courage.

PERSONAL.—Prof. W. A. Rogers died at Waterville, Maine, March 1, 1898, aged 61 years. He had been professor of physics and astronomy in Colby University since 1886 but expected to remove to Alfred University the present spring.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON.

CLEVELAND, OHIO.

CICADA TREDECIM.—This insect is now visiting the Mississippi Valley. It is a well marked variety of Cicada septendecim, or so-called Seventeen Year Locust or Periodical Cicada. The insect now seen is a thirteen year Cicada. It lives thirteen years underground in the larval and pupal stage and then as a perfect insect emerges into sunlight. Entomologists recognize several well-defined broods of this strange insect, the present brood being called No. VII. This brood last appeared in 1885. The brood in question ranges from Southern Mississippi and Northern Louisiana up along the river through Tennessee, Southern Kentucky into Southern Illinois, with quite a patch in Missouri. A fine treatise on this insect with illustrations is contained in the U. S. Agricultural Report for 1885 on page 233 et. seq., and illustrated page 347 et. seq.

A WHITE-FISH'S STOMACH.—The contents will be found to be almost exclusively composed of crushed remains of microscopic crustaceans, principally of Cyclops and Lynchnis. What the cyclops lacks in size and weight it makes up in numbers. Should one female lay ten eggs at a time in three months she will lay eight times, so that at the end of a year her descendants would equal 4,442,189,120. If we calculate that one cubic inch will contain ten millions, then the progeny of a single female from January to December will amount to 444 cubic inches of solid food, as much as a single fish could consume.

BAZZANIA.—This is a genus of liver or scale mosses. The genus has two species in this country—trilobata and deflexa. The first species is found in wet woods and the second on rocks. They are pretty and easy to exam-

ine. Remove all dirt and examine, covered in a drop of water. Examine the slide with the cover up and also reverse the slide. Along the stems will be found the amphigastria or under leaves. It makes a beautiful show under a one inch objective. It may be mounted and well preserved in glycerine jelly.

EDITORIAL.

Postal Microscopical Club.—A 16 page pamphlet, issued by the President, R. H. Ward, M. D., and the Secretary, Dr. Shanks, contains the twenty-second and twenty-third annual reports. The club has been in continuous operation since 1885. Its membership remains about the same, and about thirteen boxes of slides pass from member to member each year through the mails. The Club reports having had some of its boxes crushed and absolutely destroyed by the rough treatment of the postal cars grabbing up mail bags on too swiftly moving trains or throwing the bags off from such trains. This only occurs at small stations, suggesting that no member should be permitted to send or receive the boxes at suburban stations. If the members are restricted to using post-offices in cities and large towns, this difficulty would be largely obviated. Another difficulty which has always annoyed the officers is the holding of boxes too long before forwarding them to the next station. As a remedy for this each member should be compelled to deposit \$5 or \$10 to the Treasurer so that fines may be rigorously assessed for each violation of the rules. The annual dues \$1 cover the officer's expenses for slides, boxes, postage, expressage, stationary and printing.

A new special series of boxes have been in service for several months. Half of these are six-slide boxes devoted to special subjects and contributed by members who have made special studies in certain fields. The other half which are circulated alternately with the first are two-slide boxes and a few with three-slides accompanied with

elaborate notes for the benefit of those persons who wish to make a serious study of the objects or to gain experience and efficiency in somewhat advanced fields of research. These boxes each contain one botanical and one zoological specimen. Most of the notes have been made by Dr. Ward, Dr. Shanks and C. M. Vorce. Others are invited to contribute for next year. Some of the members have testified their high appreciation of the boxes and the notes as being superior to any of past years.

The membership is divided into circuits. While a box is passing through a circuit, including six or eight addresses, it is out of sight of the Secretary. If the box fails to complete its circuit on time, the Secretary is put to great trouble in tracing it. This is where "one sinner destroyeth much good." Last year a circuit was necessarily dropped because no boxes could be got through it or could even by any amount of special effort be got back from it except after months of delay which was simply ruinous to the plans of the officers. It would give us pleasure to publish the names of the members of that circuit if the officers would kindly furnish them to us. If, however, they neglect the system of fines, suggested above, they will lose a part of our sympathy. There are some vacancies in the well behaved circuits and co-operation is desired in finding suitable persons to be made new members.

SCIENCE-GOSSIP.

Preserving Media for Biological Preparations.—The following fluids are recommended by Amann for preserving biological specimens: *Lactophenol*: Carbolic acid, 20; lactic acid, 20; glycerin, 40; distilled water, 20 parts. Recommended for fronds of mosses, hepaticæ, fungi, and algæ. *Lactophenol copper solution*: Crystallized chloride of copper, 0.2 part; crystallized acetate of copper 0.2 part; distilled water, 95.0 parts; lactophenol, 5.0 parts. For preserving chlorophyll, recommended for Demidiaceæ, Palmadaceæ, Confervæ, etc. *Concentrated lactophenol copper*

solution: Crystalized copper chloride, 2·0 parts; crystallized copper acetate, 2·0 parts; lactophenol, 95·0 parts; water containing algæ is mixed with 10 per cent of the above solution. The whole material is preserved thereby for a long time. *Lactophenol glycerin jelly*: White gelatin, 85; distilled water, 44; glycerin, 30; dissolve by heating on the water bath, filter and mix with 10 parts of lactophenol. *Lactophenol copper glycerin jelly*: Prepared as above with the substitution of 10 parts of lactophenol copper for lactophenol. Phyocyanin and chlorophyll retain their color excellently in this medium. *Lactophenol gum*: A strong solution of gum arabic in water 1, glucose 2, and lactophenol. For preparing mosses for the herbarium. *Potassium mercuric iodide glycerin*: The author states that the salt dissolved in concentrated anhydrous glycerin gives a mounting medium of 1·78 to 1·80 refraction index. He recommends the mixture for Diatomaceæ. The preparations are ringed on with amber or dammar varnish mixed with two per cent of boiled linseed oil.—*Pharm. Centr.*, xxxviii., 544.

Astronomy.—The microscope is useful in astronomy—(1) As applied to the graduated arcs of measuring circles in astronomical instruments of precision, and to the fine divisions on the measuring rods used in determining a base-line,—the fundamental measurement in astronomy. The microscope micrometer, which contains the microscope as an essential part, is used extensively; (2) In the measurement of the position of stars on the Astro-Photographic Charts and plates obtained by the International Congress for their catalogue of all stars of the first eleven magnitudes; (3) In the determination of differential stellar parallax from photographic plates; (4) In the study and observation of the heavenly bodies as advances in astronomical photography make it possible to produce slides of sufficient fineness for the purpose.

Woods.—L. W. Hahn, Silver Creek, N. Y., offers 110 varieties of foreign and native woods for \$3.00.

THE AMERICAN

MONTHLY

MICROSCOPICAL JOURNAL.

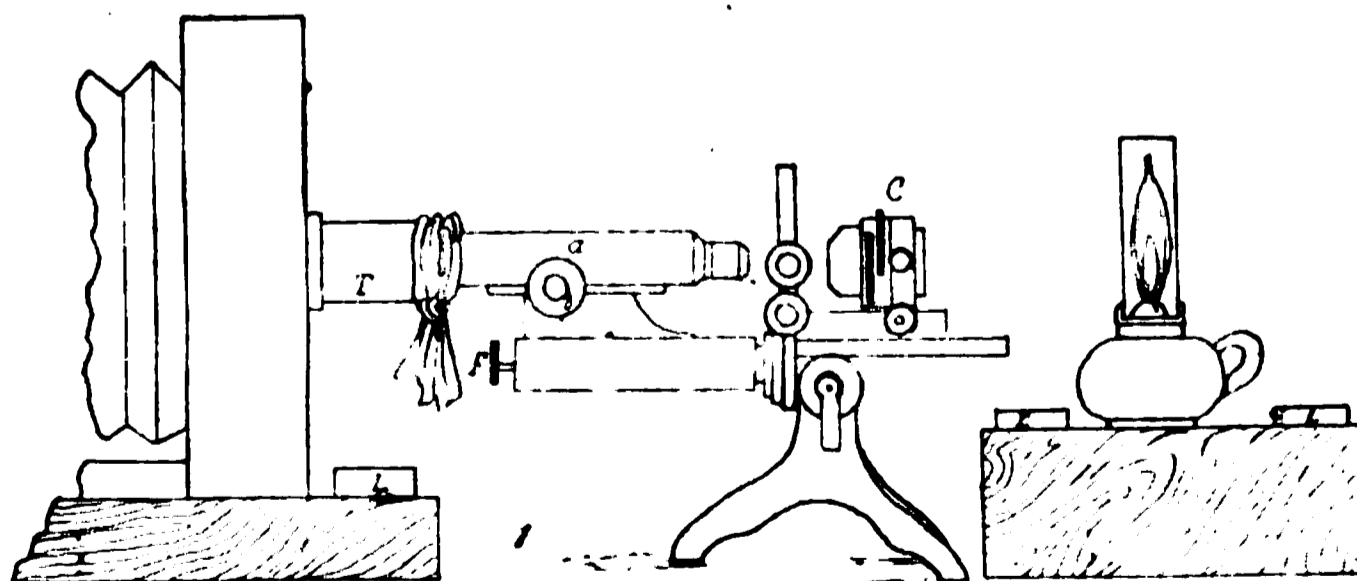
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Photo-Micrography.

The essentials are a light source, a microscope, a camera, and objects. Better results with less trouble can be obtained by using artificial light, which may be



either limelight or lamplight. Lamplight should take the form of the ordinary microscope lamp, although, any flat-flame lamp with wick slit, of preferably one inch in length may be used.

See that your wick is quite dry, and that you have the best paraffin ; dissolve one ounce of camphor in every pint, fill your lamp about three parts full, light the wick, and turn it till the flame is about three-quarters of an inch high ; allow it to burn for fifteen minutes, and then turn it up as far as it will go without flaring or smoking, let it burn for another five minutes, and if there is no sign of smoking all will go well. The lamp should always be turned with the edge of the flame to the microscope, the flat of the flame should never be used except with a bull's eye.

The camera need not be elaborate, if one is in use for ordinary photography, no matter what size it is, it can be used. But to those who do not possess a camera, it is by no means difficult to rig up an apparatus, which though costing but a little will serve as well as a special outfit. When a camera has to be made, make it of small size, and it will be found that a quarter plate, $4\frac{1}{4}$ by $3\frac{1}{4}$ inch, will be quite large enough. The length of camera is important, for upon the extension of the camera depends the amplification of the image. It is advisable, therefore, to have a camera which will extend to at least 4 feet 6 inches. It can be used either with or without an eye piece.

In making a camera, the first thing to do is to purchase your dark slide. Cheap dark slides with a focussing screen frame may be obtained, and it is advisable to purchase the two because one of the main difficulties in making a camera at home is to obtain perfect register between the focussing screen and sensitive plate. The camera should be made in three sections, sliding one within the other, and that portion nearest the microscope should be the larger. A very stout varnished millboard can be bought ; this is nearly a quarter of an inch thick. Measure the exact size of your focussing screen frame, which we will suppose to be $5\frac{1}{2}$ by $4\frac{1}{2}$ inches. We shall

then want a piece 19 inches by 20 inches; this must then be cut into strips 19 inches long, two measuring $5\frac{1}{2}$ inches in width, and two $4\frac{1}{2}$ inches in width. These when joined up at the edges will form a box 19 inches long by $5\frac{1}{2}$ by $4\frac{1}{2}$ inches. To form the corners it is advisable to get a carpenter or joiner to make angle pieces of oak or beech, the section of which will be somewhat like an L, with equal width of the vertical and horizontal arms. On to these angle pieces, which which must be about 1 inch wide and 19 inches long, the millboard may be fastened by fish glue and short brass brads; the angle pieces must be inside. Having made this box, fasten the focussing frame on to one end with fish glue and brads. Measure the exact external size of this box and procure some more millboard, and fix up in exactly the same way, so that it will just slide outside the other box. You will then have a camera with a sliding body, which will extend to 36 inches and close up to 18 inches. If thought desirable a third section may be added, but this will hardly be required. In place of millboard it is possible to use black twill, lined with ruby fabric. What is wanted is a sleeve of black cloth with elastic run into the four edges so as to make it contract and enable it to be pulled out.

If cloth is used, the focussing frame must be screwed to a stout wooden frame, which is provided at both sides with brass tongues and screws to screw into a stout wooden plank, so as to keep it upright. The millboard is preferable.

To make the camera front it is merely necessary to procure a piece of wood of the same size as the back and to this fasten the millboard or cloth sleeve. A hole must be cut exactly in the centre, of such a diameter as to take the tube of the microscope easily, with about a quarter of an inch to spare. Now procure a piece of cardboard postal tube about 4 inches long, and glue this into

the hole in the front of the camera. The base board should be 8 inches wide, 8 feet long, and 1 inch thick—2 inches in thickness is better. It should be well planed on one surface. Beech, mahogany, or oak are the best woods, pine should not be used. Draw a straight line down the middle of the planed surface, the use of which will be seen afterwards.

The microscope may be of any pattern provided the body may be turned absolutely horizontal. Most modern microscopes can be placed in this position, but frequently they are unsteady when so placed. In such a case have two iron shoes screwed to the long base-board, and under these shoes slip two of the legs of the microscope; for the third foot have a hinged shoe with screw so that it can be placed over the foot and screwed up tight so as to hold it steadily. Some modern microscopes have a horseshoe foot, in which case procure about four pounds of lead in a block and place this over the foot.

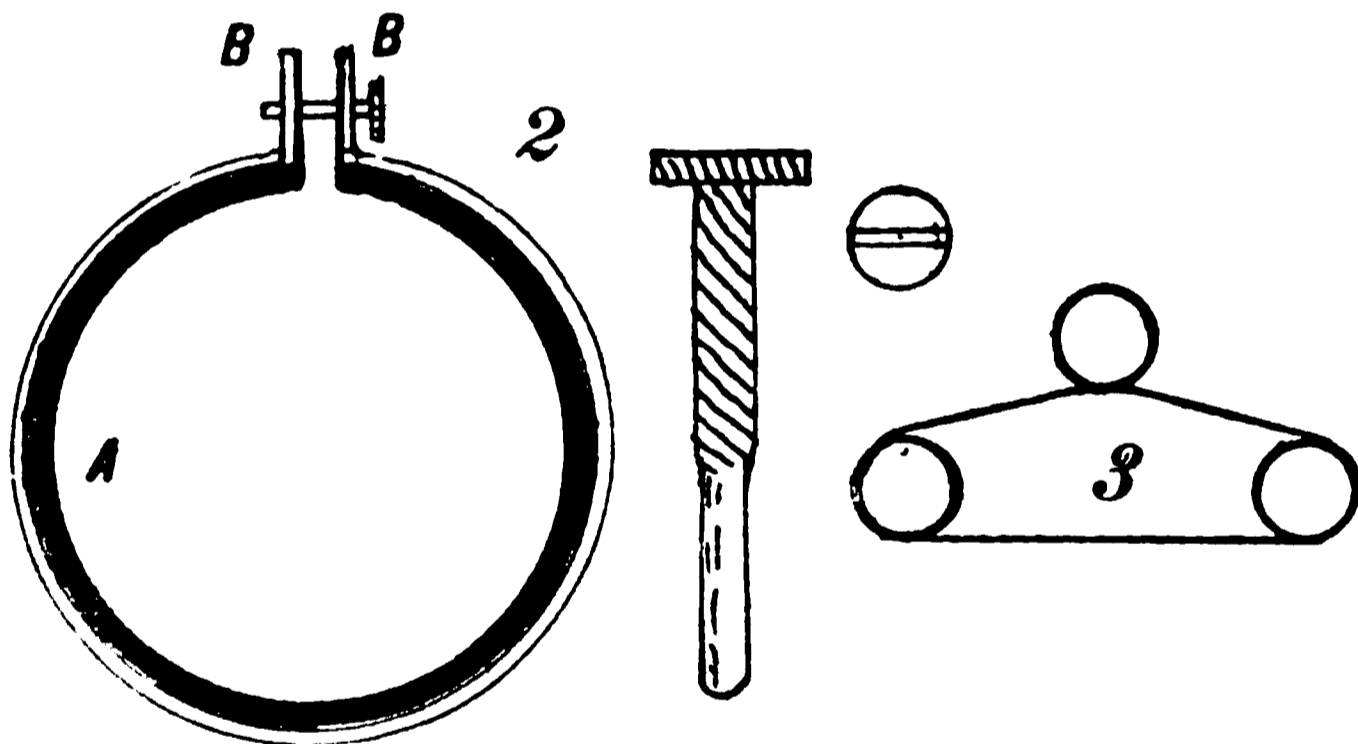
The microscope should have a substage condenser, but if this does not form part of the outfit, then a low power objective should be placed below the stage.

The objective will, of course, be already part of the outfit, but for those who wish to purchase new ones, there are few which can beat the new hard semi-apochromats of Mr. Reichert, of Vienna, a 3 mm. of this type of quite new construction having passed most successfully through some very severe tests. Still, good work can be done with an inch, half-inch, or quarter-inch, though better work can of course be done with fine diatom markings, etc., with a one-sixth or one-eighth.

In ordering new objectives it is essential to insure their being corrected for the chemical rays, though with anything higher than a one-sixth inch this can be ignored. For objectives of lower power it is advisable to use a strong tincture of litmus in a flat-sided cell or tank of

about half an inch internal measurement. Such tanks may be bought from any photographic dealer, as they are designed for use with the optical lantern. The action of the litmus solution is to cut out or absorb all the yellow rays, by which in the ordinary way focussing is effected, and leave only the blue and violet, to which the plate is most sensitive. Any old objectives can, however, be corrected by an optician.

It is essential that the microscope should have a fine adjustment and one that works steadily, so that when in use the image of the object will not shift from side to side. If this is underneath, as shown in Fig. 1, and, as is usually the case, it has a groove in the milled head, a



piece of fine silk twist or catgut should be passed over it and then carried round two ordinary cotton reels with grooves cut in them, as shown exaggerated in Fig. 3. One of these reels should be provided with a cross saw cut, as in Fig. 2, into which can be fitted a square-sided rod of brass fastened to a long handle, which is supported on wooden pillars, to the back of the camera. At this point it ends in a milled head, which enables the operator whilst examining the focussing screen to manipulate the fine adjustment. If the fine adjustment has no groove, then a small collar of brass lined with a couple

of thicknesses of box cloth, and a screw working through two eyelet holes, as shown in Fig. BB, may be used; this slipped round the fine-adjustment and tightened up and connected with the long brass handle will enable fine focussing to be perfected. A is the box-cloth and BB the tongues with screw.

The question as to whether an eye-piece should be used or not depends to a great extent upon individual taste, but it has this great advantage, that when an eye-piece is used, the extension of the camera is considerably less for any given magnification, in comparison with that required when no eye-piece is used. The eye-pieces in general use are the Huyghens, Ramsden, orthoscopic, compensating and projection oculars. For those who intend to do really good work in photo-micrography, the projection oculars should be obtained. They are made by several firms, Reichert, Zeiss, Swift, Powell and Lealand, and Beck, and usually they are made in four sizes, 2 and 4 for Continental tube length, and 3 and 6 for English tube length.

Ordinary ground glass as supplied by camera makers is utterly useless for focussing upon. It should be replaced by a dry plate treated as follows:—Place the dry plate without exposure to light in a clean solution of hypo.(1:4), allow it to remain for fifteen minutes, then wash thoroughly for an hour in running water, allow it to drain, and immerse for ten minutes in 5 per cent. solution of sulphuric acid. Finally rinse and immerse for the same time in 2½ per cent. solution of barium chloride, and wash well and dry. This treatment precipitates a very fine deposit of barium sulphate in the gelatin which is easy to focus on. Instead of this, a sheet of plate glass about ⅛th inch thick may be used, on one surface of which, (that nearer to the microscope), fine lines crossing each other at right angles in about half inch squares have been ruled with a diamond. When an eye-piece is

used on this so that the ruled lines are sharp, one can readily detect when the image is sharp.

The extension of camera determines the linear magnification of an object, and as half the value of a photomicrograph for educational purposes is dependent upon the degree of magnification being known, it is just as well either to work always with a given extension for each power or to calculate out each time the amplification. "The linear amplification of a projected image is the distance between the image and the posterior focus of the lens system, divided by the focal lengths of the system. The posterior focus of the lens system corresponds in the microscope exactly to the upper side of the ocular. It follows from the preceding data that the amount of amplification of an image for any distance between ocular and screen is found by dividing this distance, expressed in millimetres, by the focal length of the objective used, and multiplying the quotient obtained by the number of the ocular" (Van Heurck).

The initial power of a lens is found by dividing 10 (the nearest average distance of distinct vision in inches) by the focus of the objective, thus 10 divided by $\frac{1}{8}$ = 80, the initial power of $\frac{1}{8}$ inch. If this be multiplied by the power of the eye-piece, it gives the magnifying power of the combination; thus with an eye piece magnifying 3 times we have $80 \times 3 = 240$ diameters. To apply this to a camera a proportional sum is used:—As 10 : the camera length :: microscope amplification : camera amplification. Example: Using a $\frac{1}{8}$ inch objective, eye-piece magnifying three times, and camera extension of 24 inches, required the magnification—

$$\text{As } 10 : 24 :: 240 : x = 576 \text{ diameters.}$$

If the objective alone is used, then the length of the tube must be added. A $\frac{1}{8}$ th inch on a 10 inch tube and camera extension of 24 inches will give us:—

As $10 : 24$ plus $10 :: 80 : x = 272$ diameters. This shows clearly the advantage to be gained by using an eyepiece.

These are but rough and ready rules; for very exact work it is essential that a stage micrometer should be used, and the enlarged image divided by the real measure gives the magnification.

Modern Methods and Their Achievements in Bacteriology.

In order to convey some concrete idea of the extreme minuteness of bacteria, it has been mentioned that if a postage stamp $\frac{7}{8}$ inch long and $\frac{3}{4}$ inch wide (22.2 mm. by 19.05 mm.) were covered by a single layer of the typhoid bacteria, placed end to end and side by side, 500,000,000 bacteria would be required; and further, that the same area, covered to the depth of one-tenth of an inch (2.54 mm.) would accommodate no less than 2,000,000 million of these microscopic creatures. If beef-broth be sterilized, and to the limpid liquid be added bacteria known as *Staphylococcus aureus*, in the proportion of 246 per cubic centimetre of broth, and the whole maintained at the temperature of the animal body (about 98 deg. F.) for twenty-four hours, it will be found that the liquid has become quite turbid, and calculation will reveal the presence of 20,000,000 bacteria in every cubic centimetre of the solution. In other words, each original bacterium has become 80,000. The bacterium which causes fowl cholera, an epidemic disease which quickly decimates a large fowl yard, is so abundant that the blood of an infected fowl teems with them to the extent of 15,000,000 to each cubic centimetre. Indeed, if one-fiftieth of a drop of this blood be injected into a healthy rabbit the animal sickens and dies in twenty-four hours, and the blood in its body contains about 12,000,000,000 bacteria.

The lecturer then described the methods now in use of cultivating bacteria in solid media, and which were first introduced in 1881-82 by Robert Koch. It was mentioned in passing how great were the benefits conferred upon humanity by the rapid increase in our knowledge of bacteria, due mainly to these methods, especially in the departments of medicine, chemistry, and botany. A series of slides was then shown, illustrating the cultivation of bacteria by the use of solid media, their identification by appropriate methods of culture and various modern methods of artificial staining. It was shown how bacteria may thus be sifted out and determined specifically by accurately noting their morphological and biological characters. One slide showed a culture of some bacteria collected in Oxford Street at mid-day, by exposing a bottle containing beef-broth to the air for a few minutes. A portion of the broth was mixed with gelatin, spread on a glass plate $3\frac{1}{2}$ inches (88.9 mm.) in diameter, and placed for a few hours in an incubator. The result of this treatment was that the isolated bacteria multiplied enormously and founded colonies, which could be transferred to other portions of the nutritive medium and sub-cultures so obtained. A sample of sewage was diluted to a known extent, mixed with a definite quantity of medium, and similarly treated. In this way it is possible not only to identify and sift the multitudinous forms of bacteria, but also to estimate their number and roughly compute their weight. Thus the sewage was found to contain about 2,000,000 typhoid bacteria per cubic centimetre, and it is estimated that about 40,000 million *Staphylococcus aureus* weigh 1 gramme.

The lecturer showed conclusively the absolute futility of chemical analysis, of water, unless it is supplemented by a careful bacteriological examination. It has been stated by the most eminent authorities on water analysis

that the presence of 0.05 of organic matter per 100,000 parts is a negligible quantity. Some time ago a water was described as containing 1 grain (0.0648 gramme) of organic matter in 5000 tumblers, *i. e.*, one 5-000th of a grain (0.00001296 gramme) per tumbler. Now, granting that this organic matter represented bacteria, and in weight they resembled the *Staphylococcus aureus*, it follows that each tumbler contained the alarming proportion of over 518 thousand typhoid bacteria. If we go a step farther and consider the alarming rate at which the cholera bacteria multiply in the blood of a healthy rabbit, we cannot fail to grasp the shockingly fatal results that may accrue from an imperfect examination of a sample of water infected with the typhoid bacterium. The fact was emphasized that infinitesimal weights of bacteria cannot possibly be detected by the aid of purely chemical methods, and that no examination of water is complete unless it has passed through the hands of an expert bacteriologist. One-sixtieth part of crude sewage in 100 c. c. of distilled water gives a proportion of about 1.7 of sewage per 10,000 of water. Chemical analysis detects this small amount of organic impurity, but the chemist looks upon this sample of water as one of exceptional organic purity, and passes it as a first-class potable water. But the bacteriologist has methods at command which enables him to detect far smaller proportions of organic matter, and he sees great danger when water is contaminated with sewage to the numerically small extent of one part in 500,000.

The lecturer passed on to consider the conditions that affect the growth and vitality of bacteria. All bacteria may not be present in a given area in the same proportion, and if a culture be made in a nutritive medium that favors the growth of all alike, it is possible to miss specific bacteria that may be of great importance.

It is customary, therefore, to add to the media certain substances that are known to retard the multiplication of the rabble, whilst they favor the growth of the few. The addition of 1-500th per cent of carbolic acid acts in this way, and is largely used in the case where, *e. g.*, it is required to find *bacillus coli*. By adding sewage to phenolated broth a pure culture of *B. coli* may be obtained. This medium is favorable also to the typhoid bacillus, and both multiply well in a medium prepared from a sterilized infusion of potato mixed with gelatin and iodine. The incubation period for these two varieties of bacillus varies from twenty-two to forty-eight hours. It was noticed that whereas the *B. coli* develops carbon dioxide the typhoid bacillus does not. The cholera vibrio grows and multiplies best in a medium containing 1 per cent of salt and 1 per cent of peptone. By such devices the specific bacteria may be isolated from other varieties, and in the form of a sub-culture spread upon glass, dried, stained, and examined. In 1893 the value of this selective method was proved in a striking manner. A man died from an unknown cause, an inquest was held on the body, and as a result the death attributed to pneumonia. Another doctor, somewhat sceptical about this conclusion, took a portion of the dead man's bowels, mixed it with gelatin and placed it in an incubator for ten days. Then a portion of the putrid, evil-smelling substance was transferred to a peptone solution, a plate culture of the same prepared, and the presence of the cholera bacillus proved beyond the shadow of a doubt. Dr. Klein described another method of sifting, depending on the principle that whilst some bacteria thrive in air, others are killed thereby. These two classes are described respectively as ærobic and anærobic bacteria. The cholera bacillus and *B. coli* are examples of the former class. Anærobic conditions are attained by a variety of methods, including the absorp-

tion of oxygen by alkaline pyrogallol and its removal by the use of an air-pump. If milk, boiled and sterilized, be mixed with sewage, placed under anærobic conditions, and examined after twenty-four hours' incubation, it will be found clear in one part, while the top and bottom portions of the vessel will be occupied by a coagulum. The liquid literally teems with anærobic bacteria.

Bacteria which cause phosphorescence on old, rotten wood, and the bones of dead fish next received attention. In such cases the bacteria either themselves become luminous or else produce a luminous secretion. A medium composed of broth with small proportions of sodium chloride and asparagin favors the multiplication of these luminous bacteria in the course of 48 hours incubation. An exquisite photograph was shown of a flask filled with a fluid charged with such bacteria; the plate and flask were left in the dark for several hours and a strikingly beautiful picture was produced. Slides were then placed in the lantern, showing many specific forms of bacteria, including those of anthrax, tuberculosis, influenza, as well as those which convert urea into ammonium carbonate, nitrites into nitrates, and give rise to other well-known and important changes in nature. It was shown how useful are the bacteria which invade the roots of leguminous plants in enabling a plant to absorb its supply of nitrogen direct from the atmosphere. The question of the choice of suitable dyes was then discussed, and the various aniline dyes, *e. g.*, methyl blue and gentian violet passed in review. A slide was exhibited of the bacteria cultivated from the expectoration of a person suffering from tuberculosis. The culture had been stained with fuchsin and then treated with nitric acid, which discharges the color from all bacteria except the tubercular bacillus. The discovery of a method of isolating this dreadful scourge was made in 1882 by Koch, and enabled him to prove conclusively that tabes

mesenterica in children, lupus, scrofula and many other loathsome and unmentionable diseases are but different forms of one and the same complaint, viz., tuberculosis. In conclusion Dr. Klein said that though he would place high in the list of famous achievements Simpson's discovery of the use of chloroform, Jenner's method of vaccination with calf-lymph, and Lister's antiseptic surgical methods, yet he reserved the highest place of honor for Koch's discovery of a method of isolating the bacillus of that fell destroyer, tuberculosis.—Dr. Klein at the Royal Institution, London, reported in the *Phar. Jour.*, June, 1898.

Practical Suggestions.

BY L. A. WILLSON,

CLEVELAND, OHIO.

TEXTILE FIBRES.—In the Agricultural Report referred to in the last article on page 90 is a fine essay on the testing and discrimination of textile fibres. Cold nitric acid will destroy silk and leave cotton untouched. The action of muriatic acid is the same. On a cotton fibre place a drop of sulphuric acid and follow quickly with a drop of the transparent solution of the tincture of iodine. The fibre will form into disks or beads of a beautiful blue color. Flax is affected in the same way but more conspicuously. Wool treated with commercial sulphuric acid or strong diluted sulphuric acid will liberate the surface scales at one end and they will then appear under a low power as hairs proceeding from the body of the fibre. The fibres of dyed black silk are interesting under the microscope when prepared as follows: A few threads of the warp are placed on a glass slip in one or two drops of concentrated nitric acid, the black color changes to green, then to blue. A life-like motion is observed in all the fibres, and they appear marked cross-wise like the rings

of an earth worm. The acid will finally dissolve the fibre.

POLARIZED LIGHT.—The following rather unreliable but curious rapsody is copied from an old school chemistry :—“Fancy yourself in a region solely illuminated by *Aurora borealis*, imagine a country where every passing cloud throws a diverse colored shadow of gorgeous hues across your path, where the air breeds rainbows without the aid of a shower, and where the summer breeze breaks these rainbows into irregular lengths, fragments and glittering dust, scattering them broadcast over the land, like autumnal leaves swept by a gale from the forest and you have an approximate, and by no means exaggerated idea of the effect of polarized light on substances capable of being affected by it. For it is light endowed with extra delicacy, subtlety and versatility. it renders visible minute details of structure in the most glaring colors ; it gauges crystalline forms of infinitesimal thinness ; it betrays to the student's search otherwise in appreciable differences of density or elasticity in the various parts of tissues. Indeed, as a detector, polarized light is invaluable, acting the part of a spy under the most unexpected circumstances. It denounces as cotton what you believed to be silk ; it demonstrates disease where you supposed health. It adorns objects that are vile and mean, whose destiny is only to be cast out—such as paring of nails, shavings of animal hoofs, cuticle rubbed or peeled from the stems of plants, offscourings of our kitchens and store rooms, sugar, acids and salts—with the most magnificent, the most resplendent tints such as are seen when the sun streams through the stained glass windows of a Norman cathedral.

UNRESTRAINED IMAGINATION.—It is always wise in science, to be calm and to avoid exaggeration. Many young microscopists are apt to permit the uninitiated to deceive themselves as to the magnifying power of

the objective used. Far better is it to always advance the exact truth. Our instrument is wonderful, needs no exaggeration, but speaks for itself.

ANALYZING FLOWERS.—For this purpose, a good dissecting microscope will answer nearly every requirement. This should be supplemented by a case of dissecting instruments, such as knives and mounted needles.

ANALYZING MOSSES.—For this purpose a first rate compound microscope is indispensable. Here every part of the plant is often diagnostic. The protonema, the costa of the leaves with guides and stereids, the antherids, archegones, the perichetal leaves, the seta, the stem leaves, the branch leaves, the capsule, the calyptra, the operculum, the peristome, the spores and in fact nearly every part is frequently brought into requisition. Few studies will require more attention or develop more microscopic acuteness than the analysis of mosses.

EDITORIAL.

The Nerves.—Some very extended microscopic studies of the nerves have been made by foreigners and Prof. Barker has compiled the results in the N. Y. Medical Journal. The illustrations largely photomicrographs have already reached one-hundred and two in number.

Necrology.—Dr. D. P. Frame died at Kansas City, Mo., Feb. 25, 1898, having been a veterinary surgeon for twenty-five years but, for two weeks prior to his death he was a government meat inspector at Kansas City, having just moved there from Colorado Springs. He was a good microscopical student, a subscriber to periodicals, and a member of the Postal Microscopical Club.

Diatoms.—The flora of the Pacific coast excels that of the Atlantic in elegance and abundance of forms, though not in number of species. Algæ may be found covered to the depth of a quarter of an inch with deposits of the

characteristic forms of the region—*Arachnoidiscus ehrenbergii*, *Isthmia nervosa*, *Hyalodiscus subtilis* and *Rhabdonema crozieri*. C. S. Boyer is studying them.

Irridescence of Water-proof Cloth.—An American manufacturer anxious to imitate the English goods spent much money to discover the secret preparation. George E. Fell dissected a piece under the microscope and discovered starch granules with polarized light. Comparing with various kinds of starch, he found it to be potato starch. This information could probably have been sold for \$500 or \$1,000 if Mr. Fell had demanded it.

Larva of Dermestes.—In drug stores, they burrow into all kinds of roots and even sticks of extract of liquorice. Their appetite for paint brushes results in their eating up the bristles. Druggists fumigate with benzine or with bisulphide of carbon. An ounce bottle half filled and set in their way uncorked, will kill all that are near. They make pretty microscopic objects.

The Hermit Crab's Cutting-hairs.—F. S. Morton kept several hermit crabs in an aquarium and observed their habits. When a bit of food touched their antennæ, they grabbed it and rolled it about with their foot-jaws by a sawing and crushing motion before crowding the food into the mouth. A microscopic study revealed the cause of the motion. The crab was simply cutting up his food preparatory to swallowing it. With a one-fifth inch objective can be seen double rows of very sharp teeth on each hair. When jammed rapidly into a bit of soft food, they quickly reduce it to pulp. The crab lives on decayed matter which these cutting hairs readily prepare, but more solid food would undoubtedly break them.

Bed Bug Hairs.—A careful examination of the body of *Cimex* with a good $\frac{1}{8}$ th objective will show it supplied with hairs which are trifid at the ends. The shaft is covered with delicate spines, long, pointing from base to tip, and lying at a very low angle in relation to the axis of the shaft. He has been flattened dorso-ventrally by crawling

under clothing during which the hairs conveniently act as anchors.

The Skin.—Nikola Tesla says that from 4,000 to 7,000 microbes light on every square foot of the human body every 24 hours. Examined under the microscope the skin would swarm with millions of microbes which feed upon the skin and destroy its freshness producing yellowness and wrinkles. He directs thorough washing daily and rubbing with alcohol. He has also invented a battery to drive them away into space with great violence.

The Microscope Inadequate.—As in small-pox, rabies, scarlet fever, typhus fever, and certain other infectious diseases, the efforts heretofore made to demonstrate the specific ætiological agent in foot-and-mouth disease have been unsuccessful. The carefully conducted investigations of Löffler and Frosch also failed to demonstrate the presence of any specific micro-organism in the lymph drawn with proper precautions from the vesicles about the mouth or udder of infected cows. Cultures in various media inoculated with this lymph remained sterile and the micro-organisms could be demonstrated by the use of the microscope, in stained preparations. Nevertheless, experiments showed that this lymph was infectious material and that calves inoculated with a very small amount of it invariably developed the disease in two or three days. From which we are sure that there exist organisms too small to be recognized by the microscope as at present developed.

Training Needed.—For the untrained eye the microscope is little better than a toy, and it may even be regarded as a dangerous instrument, because of the inevitable mistakes which the novice will make if he undertakes to decide questions of diagnosis by the use of high-power oil-immersion objectives without having had the necessary training for such delicate work. In blood examinations, especially, considerable experience is necessary in order to give value to the evidence afforded by a microscopical investigation. It is a very easy thing for the non-expert to overlook the malarial parasite, and still easier to mistake

vacuoles in the corpuscles, deformed red corpuscles, etc., for parasitic elements.

SCIENCE-GOSSIP.

Reagents for the Microscopical Examination of Food.
—Van Bastellar finds the following reagents useful for the microscopic examination of foods:—[1] Chloral hydrate, 5; distilled water, 3. This is an excellent clearing medium, and shows the structure of various cells, such as beet in chicory, and chicory in coffee, also renders detection of inorganic matter mixed with starches more rapid. [2] Aniline, 1; acetic acid, 10. Gives a bright yellow tint with schlerenchyma and woody tissue, detects powdered nut shells, olive stones, etc., in pepper. [3] Acetic acid, 1; water 2. Gives a violet tint with fragments of tissues of *Melampyrum* seeds in flour. [4] Potassium iodide, 1; iodine, 1; water 50. Renders starch distinct by coloring the granules blue and therefore making the size and shape more evident for their identification. [6] Potash, 1; water, 100. Causes certain grains of starch to swell, and thus distinguishes them from others which are more resistant. Also gives a reddish tint with tumeric and a violet color to ergoted particles in flour. [6] Methyl violet. 1; water, 300. Stains starch granules. [7] Tincture of logwood [1 in 15], 4; sodium chloride, 1. Detects presence of alum in bread, flour, etc. [8] Sulphuric acid, 1; water, 20. Gives effervescence in presence of carbonates or bicarbonates, thus detects such mixtures as chalk in flour. Also gives a blood-red tint to ergoted flour. [9] Eosine, 1; solution of ammonia, 10. Stains altered yeast cells and bacilli. [10] Hæmatoxylin, 1; water, 25; alcohol, 25; sodium chloride, 5. Resembles No. 7 in action. [11] Solution of ferric chloride, 1; water, 5; blackens acron tissues, also those of leguminous seeds. Gives a greenish tint to powdered date stones and other adulterants in pepper. [12] Copper sulphate, 1; water, 20; ammonia *q. s.* to give a clear blue solution. Gives a dirty greenish blue with some foreign admixtures with

rice. [13] Ferrocyanide of potassium, 1 ; water, 100. Gives a redish tint with flour or other substances contaminated with copper salts. [14] Fuchsin, 1 ; alcohol, 100 ; stains various tissues, notably those of pepper. [15] Chlor-iodide of zinc, 1 ; water, 50. Reacts like potassium iodide. [16] Solution of ammonia, 1 ; water, 20. Acts like No. 5, and gives blue tint with copper.—*Journ. de Pharm.* [6], vi., 228.

In Botany.—Prof. Pierce in an article on the scope of botany says: The microscopic study of plants leads us to the most fundamental questions of biology. By microscopic study a botanist discovered that all organisms are composed of cells and that these cells are minute masses of a viscid substance called protoplasm. So much alike are the microscopic processes in the animal and vegetable kingdoms that much light is thrown upon the great questions of the influence of parents on offspring, of heredity, of descent, of development, by the microscopic study of the phenomena of fertilization and development among plants. The microscopic study of the purely vegetative as distinguished from the reproductive parts of plants reveals certain mechanical principles of structure which engineers are now just beginning to follow in their buildings, especially those constructed of materials which in large masses resemble in physical qualities those microscopic elements of which plant structures are composed. The study of structure whether macroscopic or microscopic leads us to investigate the functions of the parts. This study of functions is physiology. The first knowledge of bacteria came through the botanists. The methods employed in studying and combatting them were first suggested by botanists. Precision in the manufacture and the uniform quality of the product of bread, cheese, vinegar and beer have come only in recent decades when microscopic organisms upon which these processes depend have become known and have become regularly raised like wheat or cattle. Similar methods will be obtained shortly in the production of wine and in the curing of tobacco.

Stem of Dodder.—When the haustorium has been developed the root dies and connection with the soil ceases. The stem above the haustorium twins around its host and throws out new suckers as it grows. It thus establishes itself firmly upon the victim, which it at length destroys. It climbs all indifferently—the clover, the thistle, the nettle or rag-weed, the day-flower and even the poison-ivy. It feeds upon the juice of the latter without acquiring its properties. The stem makes an interesting mount.

RECENT PUBLICATIONS.

Hemorrhoids.—E. R. Pelton, 19 E. 16th street, New York publishes at 75 cents three lectures by Dr. C. B. Kelsey advocating the humane treatment of this evil by the avoidance of surgery and deserves every praise for so doing—a very nice little book of 68 pages.

Vibration the Law of Life.—This is the title of a new book (\$1.25) by W. H. Williams of Denver upon breathing. It is based upon experiences and successes of his own and seeks to give a scientific exposition thereof. All knowledge and all happiness await him who learns and practices the proper breathings. They induce clairvoyance, clairaudience, the healing of all disease physical and mental. Though there is absolutely no mention of the phrase “Holy Spirit” in this book, all the results which the early Christians are said to have derived from the Sanctus spiritus, are independently shown by Dr. Williams to be obtainable by a special breathing. He does not however state the fact that the Greek word “pneuma” and the Latin “spiritus” always meant breath or breathing until later Christians undertook to make them mean Spirit in the sense of Ghost or invisible personality. If “pneuma” which in all other writings means breath were translated literally in the N.T. a wonderful mine of scientific knowledge would be unfolded thereby for those who know how to and do persistently practice this special (holy) breathing which this book describes to a certain extent and of which more is learned from other writers.

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Locating Objects by the Points of a Compass-Dial or of a Clock-Face.

BY R. H. WARD, M. D., TROY, N. Y.

This obvious expedient is of course known to many; but according to the writer's observation it is adequately used by few if any. It is certainly capable of greatly increased usefulness. Anyone who has seen, as the writer has witnessed many times, an experienced and competent microscopist search two or three hours for some special object known to be somewhere amidst the confusing abundance on a large mount, and then go off to bed (toward morning) without finding it, will realize the convenience and importance of having some ever-present means of knowing where to look.

For locating a certain small object among a large number strewn over a slide or a structural point in a

large section, for instance, for the sake of being able to find it again or to tell some one else where to find it, the Maltwood finder leaves little to be desired in accuracy; as the object can be directly located in one of the squares of 1-50th inch, and by recording the position in the square by tenths, readily estimated by the eye, its location can be almost infallibly determined and recorded to 1-500 inch. But this method, though on the whole the best for fine work, requires a special piece of apparatus which is not incapable of being broken in careless hands, and therefore falls far short of being universally applicable.

The rough expedient of drawing a circle on the cover-glass, around the object, is also useful in some cases; though much more troublesome and less precise, and wholly inapplicable when many objects are to be designated on the same slide.

By imagining a compass dial to be centered upon the cover-glass with North at the top, the location of any object can be stated off-hand and instantaneously, and with definiteness enough for all low and medium powers. Everything in the general direction from the center to the top would be North (recorded as "N."); and by beginning at the center and surveying to the top any object tolerably easy to recognize can be promptly found under any power up to $\frac{2}{3}$ rds, and with little difficulty up to 1-5th. In cases of special difficulty, and often with higher objectives, a medium power should be used as a finder, as in other methods. By designating the distance from the center by tenths (estimated) of the radius, further definiteness is and should be attained with no appreciable trouble. Thus an object stated to be at "N. 5" would be half way from center to top, at "E. 9" would be at the right and near the circumference, and at "N. E. 3" would be on a radius midway between the two former and about one-third of the way out. Either

one could be almost instantly found with a one-fifth objective. This locates the radius near which the object lies, to about one-eighth of the circumference, or 45 deg. Of course these angles can be subdivided by combining the letters to make 16 points of $22\frac{1}{2}$ deg. as "W. N. W." for example, but few persons could do this without some possibility of confusion.

The clock-face, a somewhat more familiar object, gives greater precision by dividing the circumference into 12 segments of 30 deg. each. The principle is the same, the directions being given by the hour figures, and the distance of radius by decimals; a system successfully used in designating instantly the location of the bullet holes made in target shooting, except that the radial distances are given by ruled circles. Here the top becomes 12, the bottom six, and intermediate points by the familiar directions of the clock-face. Thus the "3, 9" location would be at 3 o'clock, to the direct right and 9-10ths out, or identical with the "E 9" of the compass method. By the clock method the hour spaces can be readily halved by the eye, giving 24 segments of only 15 deg. each. It might be seen that an object was at the right of 12, but not as far as 1 giving $12\frac{1}{2}$; while the pointer would, with the aid of the figures, be recognized as midway between 12 and 3 o'clock, corresponding with N. E. of the compass; so that " $1\frac{1}{2}$, 3" here would be identical with "N. E. 3" of the other. With a very little practice one will recognize the 4 and 5 o'clock direction almost as accurately as the 3 or 6; and the location of dozens of small shells, scales, or other objects can be recorded almost as fast as the numbers can be written.

If instrumental precision be desired, it can be secured by centering the cover-glass around the optical axis of the microscope, and then, with the goniometer ocular or with the graduations of the concentric revolving stage,

measuring from this center the angular distance of the object above or below the longitudinal axis of the slide ; and then measuring with the ocular micrometer the linear distance from the center of revolution. Thus an object at the right and 60 deg. below the axis would be 5 o'clock, one at the left and 30 deg. above the axis would be a 10 o'clock. By this means the object can be easily located within a single degree ; but that is seldom, if ever, necessary, as sufficient accuracy for the cases to which this method is applicable can be gained, almost automatically after a little practice, by comparison with the picture of the dial "in the mind's eye."

A Description of Cells Proper.

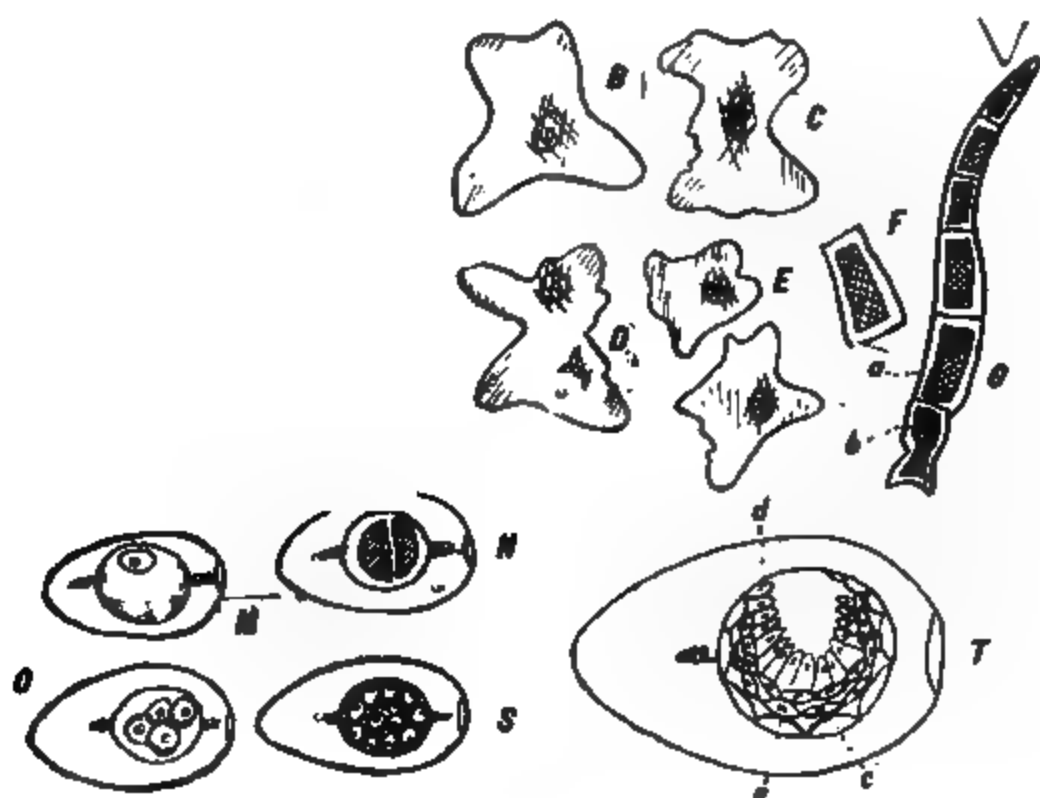
The cell is the unit of structure in all animal and vegetable life. The lowest plants and animals consist of single cells and are called unicellular. Most cells are so small as to be seen only by the microscope for they measure from 1-10,000th to 1-125th of an inch in diameter. They have to be dissected and stained for examination. Some cells consist of protoplasm with a cell-wall and others without a cell-wall. It is a viscid, nitrogenous substance, often granular, but usually undistinguishable from albumen or the uncoagulated white of an egg.

THE ONION.—A plant is made of cells differentiated into parts such as roots, stems, leaves, and flowers. The cell of an onion (figure A.) consists of a cell-wall, M, protoplasm, N, and nucleus with nucleolus, O. This is one of the best examples of a typical cell.

THE AMŒBA.—Cells reproduce and multiply by self-division and this may be best studied in the amœba. Nearly every stagnant pool contains water which examined under a rather high power will reveal a small, moving, jelly-like speck (fig. B). It is composed of granular protoplasm containing nucleus and nucleolus which

must be distinguished from vacuoles. When about to reproduce the cell becomes dumb-bell shaped (fig. C) after which two nuclei format opposite ends (fig. D) and finally the two parts are separated (fig. E).

A SIMPLE PLANT.—Take a single thread of the green scum from a pool of water. Under the microscope, find it to consist of a string of single cells (fig. F and G). The single cell, F, is afterward divided into two, and the second produces a third, a fourth and fifth and so on



until seven are shown in G, the lower cell of which is commencing to divide to form a new one. The outer wall being continuous makes a thread-like object which differs from the amœba, wherein the outer wall separating, many separate individuals are produced. Why the cells of algæ string together like a thread, when reproducing, and those of the amœba, in like circumstances, break apart, the microscope does not reveal, neither does it show why a cell made in nature is alive and one synthetically like it, made by a chemist, does not possess life.

THE EGG.—An egg (fig. M) is a primordial cell set aside for reproduction. While developing, the nucleus in the yolk separates just as in the case of the amoeba, (fig. N). The two cells then form four (fig. O) and the four form eight (fig. S) and so on until the entire yolk is occupied and there arise three distinct layers called epiblast (fig. T, c.) hypoblast, d, and the mesoblast, e. Upon these, as fundamental principles, all animal and vegetable structure is built.

Micro-Studies in Marine Zoology.

BY JAMES HORNELL, JERSEY, ENG.

A new series will be at once begun and considerably improved. The slides will be increased in number to 20, an increase of six, each of the four members of the magazine will range from 28 to 32 pages or more. The plates will number three or four in each number. A new feature will be the introduction of numerous figures in the text. The radical feature of improvement will be however, that all the text will relate to the slides and the plates. There will be no miscellaneous articles. Each instalment of slides and its corresponding number will be confined to a single class or phylum as the case may be, and hence the issue will be on systematic lines.

The Third Series will treat of the Protozoa, Sponges, Hydrozoa, and Actinozoa—one instalment to each. There will be no danger of duplication of slides already in Subscribers' cabinets, as the author will issue with each number a list of slides proposed to be sent, together with an alternative list from which substitutes may be selected for such as may not be desired in the other list.

The number to be issued first will deal with the Sponges, and will comprise some unique preparations. Special attention will be taken in the ringing of the slides to secure permanency.

All the slides we guarantee, any that may go wrong will be willingly repaired free of charge. Subscription will be inclusive of 20 slides, and 4 instalments of text and plates, \$6.75 sent post free by mail.

The completion of Series 2, was greatly delayed by reason of prolonged and serious illness combined with unusual press of business in other branches of work. For the future, arrangements have been made such as will result in a punctual issue of the Series.

The "Journal of Marine Zoology" will in future be a separate publication, and will be the organ of the Jersey Biological Station. It will be issued half-yearly.

Practical Suggestions.

By L. A. WILLSON,
CLEVELAND, OHIO.

MANIPULATION OF SOFT TISSUES.—It is very easy to obtain thin sections of soft tissues such as the tissues of fruits, trichinous pork, flesh and similar structures. Cut a very small piece as thin as possible with a thin knife. A microscopic dissecting knife is just the thing. Then place the small piece on a glass slip under a number two or number three cover and press down until the section is flattened out thin. Success may nearly always be attained by taking a very small piece. Failure will usually follow by taking too large a particle. In this way the cells and grit in a pear and the trichina in pork may be quickly and elegantly seen.

BLOOD MANIPULATION.—An old Doctor once called upon the wife of a microscopist, during the latter's absence, and requested the wife to get out the microscope to enable the doctor to examine his own blood. The Doctor lanced himself, drew nearly a teaspoonful of blood, daubed a nice, clean slide therewith, covered, examined with the microscope and saw nothing but darkness

visible. When the doctor reluctantly admitted his failure, the wife took a small particle of the blood, placed it a short distance from the center of the slip then tightly drew a smooth edged slip with a firm motion over the slip containing the small particle of blood, covered and examined when a beautiful picture of red corpuscles and white corpuscles was presented to view.

THE USE OF A BLUE GLASS BETWEEN THE SOURCE OF ILLUMINATION AND THE OBJECTIVE.—In artificial colors, white light is composed of three primary colors, blue, red and yellow. This is not true of sunlight the primary or fundamental colors of which are composed of red, green and violet. Our lamps generally emit a more or less reddish, yellow light. To correct this, use a piece of the proper blue glass obtained for the purpose from a microscopic dealer. The blue adds the other primary and makes the light practically white. After becoming accustomed to the blue glass it will be very uncomfortable to use the microscope without its aid.

FLOWER CRYSTALLIZATIONS OF SUGAR.—By the following method one will never fail in producing these crystals. Take any white sugar and in one test-tube make a saturated solution in water and in one tube a saturated solution in alcohol. Mix the two in a third test tube, when thoroughly mixed place a drop of the mixture on the center of a glass slip. The sugar will harden into an amorphous mass. When the mass has hardened, place the slip on the shade of a student's lamp. The crystals will soon begin to form. Leave the slip on the shade until they have formed throughout the mass and then remove and mount in balsam. Piso's Cough Cure placed upon a slip, hardened and set upon the lamp shade will produce the crystals. The hardened mass on the slip, placed in a damp cellar or cupboard will produce the crystalization in the course of twenty-four hours.

Can Amoeba be Formed from Bacillaria?

BY ARTHUR M. EDWARDS, M. D.,

On the tenth of last July I collected in a two ounce bottle some algæ in the salt waters of the harbor of New York. The water was ordinary salt water of the ocean. The bottle was about full, holding nearly two ounces. I took it home, examined it and found it to be *Melosira nummuloides*, a common species. I could not find any other species of *Bacillaria* and was about to throw it out. I hesitated for a while. I therefore took it out of the bottle leaving a very small quantity behind and thought I would grow it in the water and see what it came to. I put the bottle aside, a two ounce salt mouthed bottle it must be remembered, on my desk where I could examine it from time to time with a microscope, using a quarter inch objective and a one inch ocular. I had a power of about 400. My desk was at the east side of the house so that I had sunlight for a short time in the morning. The bottle was not exposed to the sun's rays so that it did not get very warm. We had hot weather nevertheless and although my window was always open the thermometer went up to nearly 100° and as there was no cork in the bottle the water rapidly evaporated. Perhaps if I had not had several years experience in growing *Bacillaria* and other things in bottles I would expect the water to become rank but it did not. There was not very much vegetable or other matter in it, and water alone cannot decay. It evaporated and evaporated. The level gradually became less until it had evaporated nearly to one quarter and was very salty. The quantity was so very small that I could not test it chemically, but it was brine. I wanted to again see if *Melosira nummuloides* would change into *Melosira borreri* as I had seen it do many years before (Published in *Grevillia*). I took some out on

the first of August and saw that it was changing into *Melosira borreri* and that there was in many times to quantitatively appeared a form that I was not prepared for. The genus *Cyclotella* was present but no species that I could identify. It was nearly transparent but looked at very closely it had fine rays or dots near the periphery of the disc. They were all alive and had rays diverging from them several times as long as the diameter of the frustule. These rays were of some substance which was not cellulose for it was too hard for that, and seemed to contain a certain amount of silica in its composition. For when the gathering was dried on the cover and ignited over a spirit lamp, it did not entirely burn away. This was an old discovery, for I had seen the same thing happen in a gathering I made ten years ago on the marshes of Elizabeth, N. J.

What was new was the presence of an amoeba. It was nearest to *Amoeba radiosa*, at least it looked like Leidy's figure 4, Plate IV, Fresh-water Rhizopods. I say it does not agree with *Amoeba radiosa* entirely for Leidy says it is "comparatively small, colorless, transparent, inactive." This was colored, light brown color and active. But what is most strange is this. It seemed to come from and be evolved from a *Cyclotella*. I saw a *Cyclotella* with its rays which I have described. I saw another *Cyclotella* with the rays more short, only just beyond the siliceous frustule. I saw another in which the surrounding cellulose was growing more and more until it assumed the form of an amoeba, and this was not an amoeba eating a cyclotella, as I have seen hundreds of times in years gone by. Soon the amoeba grew in dimensions, and by and by put forth a portion which separated from the parent and became a separate amoeba, moving slowly away. After a time it slowly stopped and then assumed the form which Leidy has figured in his figure

4, Plate IV. Then it became transparent and moved about quickly just like *Amœba radiosa*. After a time it assumed a figure like *A. verrucosa* (Leidy, Plate III, fig. 29). At this point I lost the thread of my observation. But looking at the gathering next day the amoeba were all gone and empty shells of the cyclotella were left.

Some Fine Points.

The point of a pin (fig.1) can hardly be called a fine point. It is very coarse when seen under a 1-5 objective. That of a needle (fig.2) shows a very much better workmanship. Passing from man's handiwork to that of Nature, that is to say from diluted to purer essence, we get a very sharp point beautifully tapered in the rose



thorn (fig.3). Much more delicate and minutely drawn out is the nettle sting (fig.4) while the serrate and sharp point of a wasp's sting exceeds all the rest in workmanship (fig.5). Figs 1 and 2 represent mineral, 3 and 4 vegetable, and fig.5 animal life,—the three great kingdoms of Nature in the first of which intelligence sleeps, in the second it dreams, and in the third it wakes.

EDITORIAL.

The Zoological Bulletin.—Under the editorial direction of Professors C. O. Whitman and W. M. Wheeler, is published as a companion serial to the *Journal of Morphology*, and is designed for shorter contributions in animal morphology and general biology, with no illustrations beyond text-figures.

Slides.—We have received two very interesting slides from W. A. Terry, Bristol, Conn. They represent the artificial culture of diatoms; one a two-year culture and the other a 2½-year culture. He says he has nearly succeeded in convincing Prof. H. L. Smith that they are produced from spores.

Spiders.—Many spiders use their rope-making power in seizing their prey. They not only stab and poison their victim, but tie it, wing and leg, rapidly throwing over it coil after coil of sticky ligament, which soon not only render it helpless, but convert it into mummy, thoroughly wrapped, and not only easy to carry, but put up for preservation, should the spider not desire an immediate meal.

The Gape Worm.—Dr. H. D. Walker, of Franklinville, N. Y., has for many years given attention to that disease which carries off so many fowls and has demonstrated that the earth worm is the intermediate host through which the parasite is communicated to hens and chickens. The obvious remedy is not to allow them to eat earth-worms. His first paper was read before the Buffalo Microscopical Society, Nov. 11, 1884. Further study has resulted in an illustrated pamphlet of 30 pages, published Nov. 1897. Dr. Walker has had the cooperation of Dr. Joseph Leidy and of Lord Wolsingham of England, to whom he sent slides. Those who are interested in the details of his twenty-two experiments would write to him at Franklinville, N. Y.

Laboratory Work.—From July 5 to August 27, 1898, there was opportunity at Cold Spring Harbor, Long Island, to study biology practically. There was apparatus

for microscopic photography and a limited number of microscopes for students. But each was requested to bring his own dissecting and compound microscope. The fee was \$20 for the basic course of instruction. Students not provided with compound microscopes were charged \$5 for the use of one. Board and rooms cost about \$1 per day. Mrs. Gertrude Crotty Davenport was instructor in microscopic methods.

Shameful.—One of our best friends who lives at Elgin, Ill., says that there are about forty physicians there and that not one of them knows enough about a microscope to be able to resolve a diatom. It would be a dangerous proceeding to let anyone of them manipulate a first-class homogeneous objective.

SCIENCE-GOSSIP.

The Smallest Watch.—The diameter of this is less than half an inch. The exact measurement is $10\frac{1}{2}$ millimetres, or .4137 inch. Its thickness is 3 millimetres, or .1182 inch, being but little more than a tenth of an inch. The length of the minute hand is 24.10 millimetres, or .09456 inch. That of the hour hand is 13.10 millimetres, or .05122 inch. The entire works of the tiny watch comprise ninety-five individual pieces, and its exact weight is 14.3499 grains, or, according to the metric system, 93 centigrammes—less than a single gram! After having been wound up with the diminutive key the watch will run for twenty-eight hours. The mainspring when run down has a circumference of .13396 inch. Its weight is 38 milligrammes, or .5902 grain. The weight of the four main wheels, with their springs, is 42 milligrammes, or .6468 grain. There are thirteen cogs on the little cylinder wheel, which has a circumference of 2 millimetres, or .0788 inch, and weighs .75 milligramme, or .01155 grain. The balance has a circumference of 3.57 millimetres, or .140658 inch. In one hour it completes 18,152 revolutions, travelling a distance of 9,842 feet 6 inches. The most

delicate tools and measuring instruments were made specially for the construction of this watch. The preliminary work in the making of the timepiece was very expensive, and the selling price is \$1,250.

A Flying Bullet.—Accompanying is a diagram of a photographed projectile showing the light interference produced by the sound waves which it created in its forward rush. Prof. Mach, of Vienna, was the first to photograph flying bullets and has described his work in the *Open Court*. The path of a flying bullet resembles the course



of a ship in water. It has its head wave, or bow-wave, and it has its "wake" of eddies. The head-wave, is a sound wave, and when the velocity of a bullet is greater than that of sound, the head sound-wave of a bullet reaches the ear before the sound of explosion, and so, in such cases, a discharging cannon gives two reports.

Whooping Cough Bacillus.—It has hitherto eluded the grasp of the bacteriologist, but has finally been captured by Dr. Henry Koplik, of New York, whose discovery has been confirmed by Dr. Ozapelewski, a German expert—there being only one other bacillus—that of influenza—which is as small. The whooping cough bacillus can only be seen under a very high power. It is usually in the shape of a club. Dr. Koplik, who is connected with the Good Samaritan Dispensary, has a laboratory adjoining

his clinic. For five years he has labored there trying to discover in the sputum of whooping cough patients the elusive bacillus. Though it was found in each case, its cultivation until recently was a failure. Finally, the desired result was obtained by planting the sputum on human blood serum. A tiny particle of the sputum, under the proper treatment will reveal bacilli by the thousand.

The Fresh-water Hydra.—My friends, it is true, laugh at me, and I laugh at them. They wonder why I am so devoted to “a glass globe full of water, with a few plants and snails,” and I tell them that while they see much to admire in horticulture, agriculture, and a host of other “cultures,” I am an enthusiast about hydra-culture. Indeed, in this small and insignificant aquarium I have a flock of fresh-water polyps, called “hydras,” full of interest, full of wonder. I envy Trembley, who in 1744 published *A Memoir on the Fresh-water Polyp*, the intense pleasure he felt in unraveling the life history of these creatures. He was investigating the unknown when he studied the strange phenomena connected with them, and was transported with astonishment. I know, from the labors of others, what to expect, and yet I am lost in wonder.

We may be thankful that these animals are so small as they are; for, if they were only a few feet in length, we should have in our water world many a repetition of the devastation said to have been caused by the Lernaean Hydra, whose destruction was one of the gigantic labors of the hero Hercules. As it is, the longest you can find is only an inch in length. They can, however, be easily seen with the unaided eye, and with the help of a pocket lens can to some extent be studied. In fact, Trembley, the famous observer of them, had nothing better. It is only when we wish to examine minute details that the use of the elaborate microscope is called for. A group of them attached to the rootlets of duckweed or the under side of the leaves or on the stems of plants is a curious sight.

A nearer view may often be obtained, for they will attach themselves to the side of the glass to enjoy the light, which they seem to love.—R. Blight in Pop. Sci. Mo.

Mucilage Cells.—Methylene blue has the advantage of being a decisive reagent for mucilage in plants; only some lignified cell-walls otherwise take up the color, and the stain may be applied by proper manipulation to dry as well as to fresh plant material. Fresh specimens of leaves, etc., are left for several hours in a solution of methylene blue, 0.4 gm. in 95 per cent alcohol, 100 c. c.; afterwards cut sections and transfer each to a slide with a few drops of a similar solution, in which four-fifths of the alcohol is replaced by an equal volume of nearly anhydrous glycerin. The mucilage cells are stained blue in a short time, and after covering the specimens they may be kept indefinitely, the contrast between the stained and unstained portions becoming more marked as time passes. Dried material should first be softened in water, then transferred to strong alcohol prior to cutting sections.—Am. Journ. Phar., lxx., 285.

London Air.—Its dust particles, in a suburb, number 20,000 per cubic centimeter in the open air, and 44,000 in a quiet room; while in the city the totals per cubic centimeter were 500,000 when taken from a roof, 300,000 in a court, and about 400,000 in a room. In other words, the air of the square mile is 900 per cent thicker than in the suburbs; which is in accord with the general experience that fogs are both more dense and more frequent over the center than in the outskirts. But what is especially interesting is to learn that although dust is the great carrier of microorganisms, there is only one of these articles per 38,000,000 atoms of dust. Thus it is calculated that a man could live in the metropolis for seventy years and only absorb 25,000,000 microbes into his system from the air, or about the same number as he drinks in a half-pint of unboiled milk. Of course there are other serious objections to dust; but it is something to know that there is only one microbe to many millions of motes.—London Telegraph.

Test for Semen.—Professor Florence, of Lyons, has made a discovery which he thinks may prove to be of considerable medico-legal importance, namely, that the addition of a strong aqueous solution of iodine (1.65 parts of iodine, 2.54 parts of potassium iodide, and enough distilled water to make 30 parts) to human semen gives rise to the immediate formation of dusky-brown microscopic crystals, partly long rhombic tables, and partly fine needles. C. Posner has succeeded not only in eliciting this reaction, but in determining that it is due to the combination of iodine with spermine. Hence it results that the reaction may be produced with any fluid containing spermine, and therefore is not absolutely a test for semen, although it is a valuable import as a corroborative test. Inasmuch as suspected seminal stains are practically never due to ovarian juice or other non-seminal fluids containing spermine, the Florence test will be very valuable.

Albuminuria.—The common reagents for its detection are nitric acid, Robert's formula, Millard's formula, potassium ferrocyanide, and heat. All five methods have been applied by Dr. Garratt to fifty separate lots of urine each containing a sediment whose character had been determined by microscopic examination and which indicated abumin. The experiments were for the purpose of determining the relative value of these five different methods and resulted in showing Millard's formula to be the best and almost perfect. His formula is as follows: Potassium hydrate, five-per-cent solution, twenty-two parts; acetic acid, glacial, seven parts; carbolic acid, two parts.

Cleaning Cover Glasses.—Braun recommends the following process for cleaning microscopical covers. Collect the cover glasses to which cedar oil adheres, in a glass containing methylated alcohol. Pour off the alcohol, wash with benzine, boil for about half an hour with soda solution, stirring with a platinum needle. When rinsing, rub the glasses with the hands to remove any adhering matter. Then place them for twenty-four hours into acetic acid,

and finally into 96 per cent spirit. Rub dry with a piece of soft leather, and pass through a flame.—*Ph. Ztg.*, xlii., 762.

Royal Microscopical Society.—At the last meeting the president referred to the loss the society had experienced in the death of Dr. Henry Perigal, who died at the advanced age of 98. He then exhibited and described two old microscopes, one of which, made by Benjamin Martin, probably dated from about 1770. It had two concave mirrors, one of 4in. and the other of 9in. focus. The optical part was curious, having a fixed black lens in the tube, which was common to all the objectives, each of which was fitted with lieberkuhn. The other was an antique instrument, with simple lenses fitting into one another to increase the power. It seemed to be a copy of one made by Mann and Ashcroft, somewhere about 1740, and was made by Cary. He next called attention to an excellent lithographic portrait of Prof. John Queckett, the work of Wm. Lens Aldous, whose son had presented it to the society. Mr. Fredk. Ives exhibited a camera lucida which he had devised. It was one he had obtained from Messrs. Swift, and he had slightly modified it by depositing on one of the inside faces of the compound prism a very thin specular film of silver, through which it was possible to see the pencil without having to centre the eye, as was the case where the film was opaque with a small hole in it to look through.

After some remarks by Mr. Beck, Mr. Swift said there was a difficulty in centering the eye in the old form which did not exist in the one before them, the pencil being seen with ease while delineating the object under observation. The president thought the device a valuable one, and preferable to that of a thick film of silver with a hole in it. Mr. Ives also exhibited a monochromatic green screen, consisting of dyed films between two plates of glass, which he thought possessed advantages over liquid screens. The one now shown would cut off all beyond the F line on the blue side, including the ultra-

violet, and also the red and yellow. In reply to inquiry, Mr. Ives said that, of course, the light was not strictly monochromatic: it was a mixture of pure green in the spectrum at the E line, with some yellow-green on one side and blue-green on the other.

Mr. B. W. Priest exhibited a large number of slides of sponges. He said he had brought a selection which would be found to be characteristic of the order Calcarea and the three sub-orders of Silicea—viz., the Monaxonidæ, Tetractinellidæ, and Hexactinellidæ, to the last of which he directed attention, on account of their great beauty. There were also some slides of freshwater sponges.

Quekett Microscopical Club.—The 361st ordinary meeting was held June 17th, President, Dr. J. Tatham. Mr. Vezey referred to the death of Mr. Henry Perigal, a member since 1881. Mr. A. Earland read a "Note on *Orbiculina adunca* F. and M., and its Varieties," based on the material sent him by Mr. Bryce-Scott, of the Intercolonial Railway of Canada; but the precise locality where found was not stated. It certainly contained an astonishing number of varieties of this species, of which specimens were exhibited, and a type slide was presented by the author to the club. Mr. Rousselet read a paper "On Micro. Cements for Fluid Mounts," which gave rise to an interesting discussion, in which Messrs. Morland, Measures, Nelson, the president, and others took part. Mr. Rousselet said after a lengthened experience he was obliged to retract part of his former eulogium of Clark's cement, which, while retaining unimpaired spirit mounts, had failed to keep intact watery solutions, such as formaline, and he had been compelled to remount some hundreds of slides. The general opinion of members seemed to be that it was best to use two, or even three, cements having different solvents, one over another.

Cheap Books.—Allan Wheeler, Denver, Colo., offers Carpenter's Microscope and its Revelations (\$6 book) for \$2.00. This is second-hand but good. He also has medical books in great variety.

MISCELLANEOUS.

For Sale.—A \$45 microscope stand for \$25. Address: W. A. Murrill, Ithaca, N. Y.

Books.—How to Photograph Microscopic Objects by Jennings, 75 cents; Photography applied to the Microscope, by F. W. Mills, \$1.00. Sent postpaid, by Outing Co., Ltd. 241 Fifth avenue, New York City.

Indiana Academy of Science.—Officers for 1898: Prest. C. A. Waldo, Purdue Univ.; Vice-Prest. C. H. Eigenmann, Indiana Univ.; Secy. J. S. Wright, Indianapolis; Asst-Secys., A. J. Bigney, Moore's Hill College, G. W. Benton, Indianapolis; Treas. G. W. Benton, Indianapolis.

Mirror Loup.—A new mirror loup has been made by E. M. Nelson which is serviceable either in day-light or by the light of a paraffin lamp.

New Binocular.—Beck has produced a portable binocular of same general character as his National but made so as to remove the stage entirely from the stand for convenience in packing. The stand is large, fitted with a centering apparatus and suitable for pond work.

A New Station.—A biological station containing aquaria, laboratories, rooms for collections and library is in course of erection near Sebastopol, on the Black Sea. It is expected that the building will be opened for scientific work during the present year.

Mountains.—At an altitude of 2,000 feet a search for microbes proved fruitless in Switzerland and presumably would elsewhere.

Wolmer Forest.—The Guilford Natural History and Microscopical Society has succeeded in securing the protection of birds, foxes, etc. in this forest.

Carbondioxide Crystals.—When solid carbondioxide is examined under the microscope, wire-like crystals may be seen along its edges. Branching filaments issue from them apparently at right angles and somewhat resemble the groups of minute crystals seen in crystallised iron, gold and ammonium chloride.

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To the Memory of Robert B. Tolles.

BY DR. J. W. DINSDALE, CHICAGO.

Of cypress shall ye now your garlands make,
And drowsy poppies for your sorrow's sake.

With words that halt for breath—

And through the sadness of succeeding years,
Lo! ye that live shall water them with tears
In memory of his death.

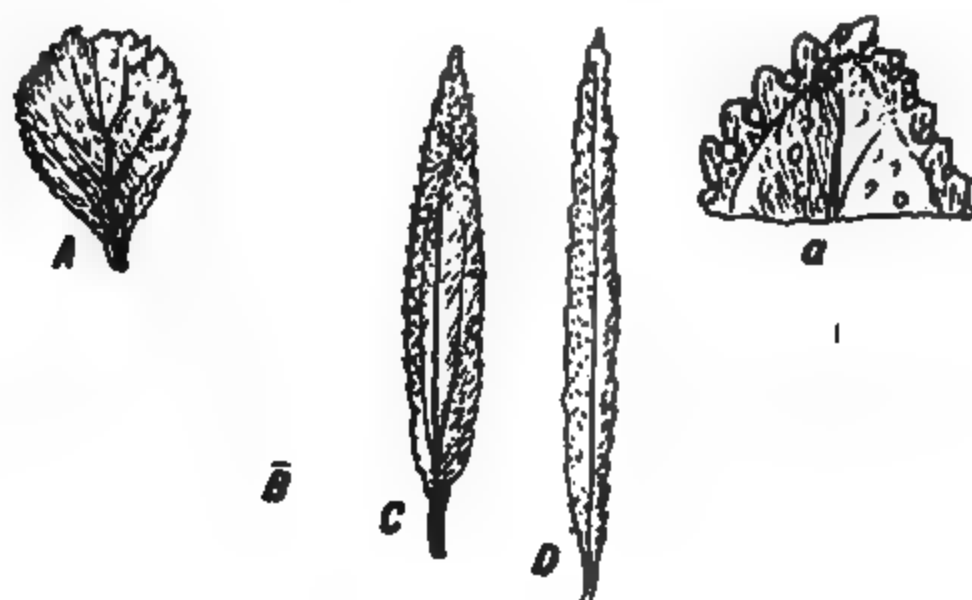
Laurels and roses shall ye also twine—

With notes of dulcimer and song divine
Shall all the air be rife—

And hearts be glad o'er all the land and sea
Joined fast in bonds of close fraternity—
In memory of his life.

The Structure of Buchu Leaves.

B. BETULINA.—The leaves vary from 1-2 to 3-4 inch in length, and from 1-3 to 1-2 inch in width, in the upper part. In shape they are obovate, cuneate below, somewhat undulate, and recurved at the apex (fig. A and a) glabrous and minutely wrinkled, with a polished surface,



denticulate at the margin, furnished with scattered oil cells, one occurring also at the base of each tooth and in the obtuse apex. The odor is characteristic, recalling a mixture of peppermint and black currant.

B. CRENULATA.—The leaves are oblong-oval or elliptical (fig. B and b) obtuse or somewhat rhomboidal, varying from $\frac{1}{2}$ to $1\frac{1}{4}$ inch in length and from $\frac{1}{4}$ to $\frac{1}{2}$ inch broad in the middle. The surface is glabrous, polished and

minutely wrinkled, and the margin crenulate. The leaf is furnished with oil cells in exactly the same way as *B. betulina*. The odor recalls that of horsemint (*Mentha aquatica*), and the flavor that of peppermint, with a trace of carraway.

B. SERRATIFOLIA.—The leaves are linear-lanceolate, varying from 1 to 1½ inch in length, and from ⅓-½ inch in width in the middle (fig. C and c). They are obtuse at the apex and serrulate at the margins, glabrous, polished, and minutely wrinkled, and are furnished with oil-cells in the same manner as the two preceeding species. The odor and flavor resemble those of *B. crenulata*, but the taste is more distinctly bitter. Buchu apparently owes its properties to an essential oil. In the case of *B. betulina* the oil affords a crystalline deposit of diosphenol which has been ascertained by Dr. Cash to possess anti-septic properties. It has an odor like menthol. The leaves also yield a ketone resembling menthone, and a hydrocarbon. The leaves in addition yield mucilage and contain hesperidin.

The epidermis consists of tabular polyhedral cells (five to six sided), without stomata on the upper surface of the leaf. These cells contain amorphous masses or sphærocrystals of hesperidin (see figure). Between the epidermal layer and the palisade cells there is a layer of colorless cells, thin and with irregular walls, as seen in alcohol or almond oil, but in water swelling up and forming mucilage by the dissolution of the walls (see figure). The mesophyll consists of a single layer of palisade cells and a spongy parenchyma beneath, sphæraphides occurring in some of the cells. The oil cavities are lined with two or three layers of flattened cells. Those at the base of the marginal teeth occupy nearly the whole thickness of the leaf. The lower epidermis is furnished with stomata. The midrib is not prominent on the upper surface, and very slightly so below. It consists of a woody

bundle with soft fiber and a pericyclic arch of lignified cells on its under surface, separated from the upper and lower epidermis by layers of polygonal thick-walled cells, which do not contain chlorophyll (fig. 1). Several species of the allied genera or of the same genus are occasionally offered in commerce, but only one occurs with sufficient frequency to demand notice. This is *Empleurum serrulatum* (fig. D and d), known in commerce as "Fine Long Buchu." The leaves resemble those of *B. serratifolia* but are narrower and longer, $1\frac{1}{4}$ to $1\frac{1}{2}$ inch long, and about $\frac{1}{8}$ to $\frac{1}{4}$ inch broad. The apex is sharply pointed, and does not contain an oil cell, although these are present at the base of every tooth. The lateral veins, which are only slightly visible in the official species of buchu, are practically not visible in *Empleurum*. The odor is very different, slightly recalling that of baked apples, and the faint flavor is rather like that of lemons and carraways mixed, but there is a distinct bitterness. Umney has pointed out that the infusion of these leaves has an odor like trimethylamine, and that ferric chloride does not produce in it the green coloration which it gives with the leaves of *B. betulina*. The leaves have a similar structure to those of buchu as regards the mucilage cells. The fruit of *Empleurum serrulatum* is often found mixed with the leaves. It consists of a single carpel, linear-oblong and compressed, with a sword-shaped beak, the whole being about $\frac{3}{4}$ inch long, of which the beak forms half. The fruit of *Barosma* consists of five carpels, opening by the ventral suture, and adhering by their margins when dehiscent.—*Phar. Journal*

For Sale.—A \$45 microscope stand for \$25. Address: W. A. Murrill, Ithaca, N. Y.

Books.—How to Photograph Microscopic Objects by Jennings, 75 cents; Photography applied to the Microscope, by F. W. Mills, \$1.00. Sent postpaid, by Outing Co., Ltd. 241 Fifth avenue, New York City.

Some Observations on Brain Anatomy and Brain Tumors.

Dr. William C. Krauss, of Buffalo, read a paper at the 92nd annual meeting of the Medical Society of the State of New York, Albany, Jan. 25, 1898, with the above title.

He called attention to the difficulty in remembering the gross anatomy of the brain, and to the almost universal presence of optic neuritis in cases of brain tumor. He attempted to overcome the difficulty in regard to the anatomy of the brain by formulating the following rules, which are somewhat unique and original, and at the same time easily remembered.

The nerve centres are divided into two great divisions encephalon, and myelon. The encephalon is divided into two subdivisions, cerebrum, and cerebellum. The cerebrum, cerebellum and myelon are divided into two hemispheres each, right, and left. The encephalon is indented by two great fissures, longitudinal and transverse. Into these two great fissures there dip two folds of the dura, falx cerebri and tentorium cerebelli. There are two varieties of brain matter, white and gray.

There are three layers of membranes surrounding the brain, dura, arachnoid, pia. Each hemisphere is indented by three major fissures, sylvian, rolandic or central, parieto-occipital. Three lobes, frontal, temporal and occipital, on their convex surface are divided into three convolutions each,—superior, middle and inferior. There are three pairs of basal ganglia, striata, thalami, quadrigemina. The hemispheres of the brain are connected by three commissures, anterior, medi, post-commissure. The cerebellum consists of three portions, right, and left hemisphere, vermes. There are three pairs of cerebellar peduncles, superior, middle, inferior. The number of pairs of cranial nerves, in the classifications of Willis and Sommering, can be determined by adding 3 to the

number of letters in each name ; that of Willis making 9, and that of Sommering making 12,) or the name containing the more letters has the larger number of pairs of nerves, and vice versa). The cortex of the cerebellum is divided into three layers of cells, granular, Purkinje's cells, a molecular layer.

Each hemisphere is divided externally into five lobes of which four are visible, frontal, parietal, temporal, occipital and one invisible, insula (Isle of Reil). Roughly speaking, the visible lobes correspond to the bones of the cranium ; that is, the frontal lobe is underneath the frontal bone, the parietal lobe beneath the parietal bone, etc. The brain contains five ventricles, of which four are visible—the right and left, (1st and 2nd,) the 3d and the 4th ; and one invisible, the 5th or pseudo-ventricle. The cortex of the brain contains 5 distinct layers of ganglion cells.

Studying carefully 100 cases of brain tumor in which an ophthalmoscopic examination had been made for the presence or absence of choked disc (optic neuritis), Dr. Krauss announced the following conclusions:

Optic neuritis is present in about 90 per cent of all cases of brain tumor. It is more often present in cerebral than in cerebellar cases. The location of the tumor exerts little influence over the appearance of the papillitis. The size and nature of the tumor exerts but little influence over the production of the papillitis. Tumors of slow growth are less inclined to be accompanied with optic neuritis than those of rapid growth. It is probable that unilateral choked disc is indicative of disease in the hemisphere corresponding to the eye involved. It is doubtful whether increased intracranial pressure is solely and alone responsible for the production of an optic neuritis in cases of brain tumor.

Fungi.

BY J. G. WALLER, PREST., QUEKETT CLUB.

Having obtained samples of sand from the lightships in the German Ocean, immediately off the English Coast, I was led into one of the most interesting subjects that ever I was engaged with the microscope. It opened up an entirely new field.

The Fungi comprise a very large family. In many cases they are what Linnæus called "Servi," going before to prepare the way or coming after to clear the way as in the case of mould. These apparently simple forms produce the potato disease, the vine pest, fungus foot of India. Yet we could scarcely expect to find Fungi excavating as they do small particles of calcareous sand and at two fathoms depth. But Prof. P. M. Duncan, found a similar deposit as far back as the Siberian age—myriad's of ages ago. Still operating in our own seas is the same eternal law.

There is however some uncertainty as to whether these organisms are algæ or fungi. Long ago Fries, a Swede, regarded them as interchangeable, and that what in water were Algæ became Fungi or Lichens in air. Kollicker called them Fungi but Dr. M. C. Cooke, moulds. But if we entertain evolution or devolution in these classes we shall not too readily make species in lower organisms. This practice has too often taken place. "Mere mycelia have been described as perfect plants, mistakes have been made in important points of structure, and productions of an undoubted fungoid nature have been referred to algæ though agreeing with them neither in habit nor physiology, while the commonest mould's have received new names, and several conditions of the same species have been registered as autonomous productions."—Berkeley.

The Fungus foot is a terrible disease which attacks the bones of the lower extremities and the victim dies of exhaustion. It has been classed as a mould by Dr. H. J. Carter. In the Intellectual Observer (II), is a good account of it. I was particularly struck with the close resemblance between his illustration and an illustration of mine in one of the objects from the Varne sand which I called *Saprolegnia varniensis*. In the mycelia the analogy is striking as also in the development of sporangia. The large family of *Mucor* may be set down as potent destroyers closely allied to each other.

Hog Cholera.

Two diseases, closely resembling each other, yet caused by distinct germs, and frequently both affecting an animal at the same time, have been recognized. The question of formulating practical measures for controlling these diseases has been as difficult as it is important. While most prevalent in the great corn-producing States, the diseases have been carried to all parts of the country, and therefore, any regulations to be effective must be enforced over a wide extent of territory, and would be correspondingly expensive. The losses have, however, been tremendous, being placed by some as high as \$100,000,000 a year; an estimate which does not appear exaggerated in the light of the careful inquiries in the State of Iowa, from which it was concluded that this one State lost from \$12,000,000 to \$15,000,000 worth of swine in a single year.

There are but two methods of control which, from our present knowledge of the contagious diseases of swine appear to promise adequate results. One is the old stamping out method, the slaughter of diseased and exposed animals, the quarantine of infected farms, the regulation of transportation, and the disinfection of stock cars,

stock pens, infected farms, and all other places harboring the contagion. The other is the treatment of diseased and exposed animals with antitoxic serum.

The stamping-out method is attended by many difficulties and limitations. Farmers often object to the slaughter of exposed animals which are still healthy, unless paid more than the animals are worth, and they are unwilling to have their breeding stock killed so long as there is a chance of saving a part of it. On the other hand it is embarrassing, if not impossible, to utilize in any way the carcasses of exposed animals which have not yet developed symptoms of disease, and to destroy these adds largely to the expense. Again, it is next to impossible to control transportation and the disinfection of cars so as to prevent constant reinfection. The disinfection of farms is also a troublesome matter, as the germ of hog cholera has great vitality, and is able to maintain its existence and virulence in the soil, in moist organic matter and even in water, for several months. Finally, the wide distribution of the disease, the ease with which the contagion is carried, the numerous agencies which contribute to its spread, are all elements which increase the gravity of the problem and militate against the success of the stamping out method.

The use of antitoxic serum appears at present to be a much more promising method of diminishing the losses, and it is possible that it may be combined with sanitary regulations, such as quarantine of infected herds, disinfection of premises, and supervision of transportation, so as to give the advantages of the stamping-out method while avoiding many of its embarrassments. The serum is prepared by inoculating horses or cattle with cultures of the disease germs and repeating these inoculations with gradually increasing doses until the animals have attained a high degree of immunity. The blood of such animals injected under the skin possesses the power of

curing sick hogs and of preventing well ones from becoming infected. Unless the blood is to be used immediately after it is drawn, which is not often the case, it is allowed to coagulate or clot, and the liquid portion, or serum, is separated and preserved for future use.

The Agricultural Department has been diligently working for several years to bring the serum treatment of hog cholera to the highest degree of efficiency. The most important point is, of course, to secure a serum with high protective and curative power. This is by no means an easy task. The products of the hog cholera germ are irritating, and when injected into the tissues their tendency is to cause paralysis and death of the part, with the formation of large abscesses. The intense local action hinders the absorption of the cultures into the general circulation and prevents the animal from acquiring immunity. It is doubtless for this reason that the inoculation of swine has generally failed to give the necessary degree of protection and that inoculated swine are found to contract cholera when they are afterwards exposed.

The serum produced in 1897, when used in affected herds, saved over 80 per cent of the animals. The methods have been considerably improved, and it appears probable that a serum of higher efficiency will be the result. There is no danger connected with the use of this serum, as it is absolutely free from the germs of the disease. It is easily applied, and the good effects in sick hogs are seen almost immediately. There is every reason to believe, therefore, that we have in this serum a practicable method of preventing the greater part of the losses from hog cholera, but it must be tested upon a larger scale before absolute assurance can be given.—*Report of Bureau of Animal Industry.*

Wolle's Diatomaceæ of North America with plates for sale cheap. Address the Editor.

Practical Suggestions.

BY L. A. WILLSON,
CLEVELAND, OHIO.

THE CENTRIFUGAL METHOD OF COLLECTING OBJECTS IN WATER.—By the use of a special, large centrifugal machine, devised by Dr. C. S. Dolly, objects in water may be accurately collected. This machine driven by hand or motor quickly separates all the suspended matter, living plants, including bacteria, animals and inorganic matter in such a way that it can be readily weighed, the total volume determined, the number of particles counted under the microscope and tables made for comparison showing the economic yield of any given area of water. This centrifugal method is of wide application and probably will be a great aid in separating diatoms. —*Scientific American*, June 11, 1898.

A CURIOUS LEAF.—Moss leaves exhibit an almost endless variety, most of them requiring the use of a microscope to reveal their peculiarities. The leaves of *Hypnum schreberi* are very curious. The borders of the leaves are recurved at the base and incurved at the apex and are persistently orange at the base. The moss is quite common. The incurved apex resembles a tube. The leaves are readily removed by holding a stem with a pair of forceps at the top end and scraping upwards with a sharp dissecting knife. One upward cut is sufficient and more scraping will injure the delicate leaves. Place the leaves on a glass slip cover, fill with water and examine with a one-inch objective. To properly study the areolation of the leaves a one-quarter objective is requisite.

ROTIFERS.—These remarkable beings are mostly found in water that has become stagnant but is partially purified by the presence of the Infusorians, which always swarm in such localities. There is, however, one very

strange residence of the common Rotifer, namely, within the leaf cells of the common bog moss or Sphagnum.— (*Wood, Animal Creation.*) The writer has already mentioned the discovery of *Rotifer vulgaris* in the under lobes of the livermoss, *Frullnaia*. The plant had been in a cabinet for at least two years when upon moistening the leaf on a slide lively rotifers were seen living in the under lobe. Sometimes two rotifers were found in company in one lobe.

* *MYRIANGIUM DURIÆI*.—This microscopic plant is described on page 261 of Tuckerman's Synopsis of North American Lichens as a member of the order Lichenes, and on page 620 of Ellis & Everhart's North American Pyrenomycetes it is described as one of the latter plants. The last mentioned authors state that "its true place in the mycological system is doubtful." Here is an opportunity for an ambitious microscopist or botanist to distinguish himself. A supply of plants may be obtained from almost any one who possesses a collection of lichens.

EDITORIAL.

Slides.—The following new preparations have been made and are for sale by J. D. King, Edgartown, Mass.

- 445. Evening Primrose. Anther and pollen.
- 42. Chalcobrichite.
- 61. Cuprite with native copper crystals.
- 131. Gold from Denver, Colo.

HYDROIDS AND POLYZOA.

- 78. *Udendrium tenue*. Two slides of different growth.
- 2. *Campanularia volubilis* on *Porphyra crona*.
- 60. *Porphyra crona*. Edgartown.
- 109. *Bugula turrita* with diatoms,—expanded tentacles.
- 19. *Bugula flabelata*.

SECTIONS.

- 34. Root of high blackberry.

3. *Asclepias*, stained to show pitted ducts and spirals and not later tubes.
62. *Clematis virginiana*. First and second year's growth.
- 72a. *Cycas revoluta*. Leaf.
78. Leaf steam of *canna*—radial structure and stellate-parenchyma.
86. Fern root. *Dicksonia punctulata*.
133. Leaf of *Trias elastica*, showing cystoliths.
234. *Lillium reseum*. Cross and surface sections of leaf.
238. Spirals of *ricenus*.
253. Transverse and longitudinal sections of mullen.
255. *Nuphar advena*.
274. Fern, *Osmunda cinomonia*.
280. Ovary of *Onothera*. Transverse section.
281. " " Longitudinal "
305. *Phytalacca*. Epidermis of leaf.
320. *Sasifras* cut thick necessarily to show pitted ducts.
321. *Sycamore*.
309. *Pauperia*. Soapwood from Brazil. Full of crystals.
421. *Zoa*. Indian corn. Long. and Tr. sections.

Rotifers.—During the warm days of June 16-18 the *Asplanchna priodonta*, was found by S. J. Hickson of Owens College, Manchester, England, in the surface waters of Lake Bassenthwaite in great abundance. He dragged a small tow-net from a row-boat for 20 minutes and the water collected in the bottle at the end of the net was rendered turbid by the multitude of individuals. Probably he would respond to calls for exchange of specimens.

American Microscopical Society.—At its recent annual session, it elected the following officers for the ensuing year: President, Dr. William C. Krauss, of Buffalo; first vice-president, Professor A. M. Bleile, of Columbus, O.; second vice-president, Dr. G. C. Huber, of Ann Arbor, Mich.; Secretary, Professor Henry D. Ward, of Lincoln, Neb.; Treasurer, Magnus Pflaum, of Pittsburg; Execu-

tive Committee, Professor S. H. Gage, of Ithaca; Dr. A. Clifford Mercer, of Syracuse, and Dr. V. A. Moore, of Ithaca;

Lime Light.—The surface of the lime is not so evenly incandesced as that of carbon. It gives a small homogeneous point of light and quite intense. But by reducing the pressure of the gas to about one inch and using a very hard lime and a jet with a medium-sized bore a fairly steady light is obtained. Still the arc light is better.

Electric Arc Lamp.—There has been great difficulty in using this light for photomicrography because the position of the arc was not constant and the source of light not uniform. Messrs. Barnard and Carter of the Quekett Club devised a form in which the distance apart of the carbon points is regulated by hand, their position thus controlled easily. By reference to cross-wires on a glass screen the source of light can always be kept in the same place. The oblique position in which the carbons are set enables the small point of intense light from the incandescent crater of the positive carbon to be used as a source of unvarying and steady illumination of small area and of very great intensity.

Dry Mounts.—The Postal Microscopical Club people have been discussing dry mounts and appear to disapprove of them as liable to deterioration. The great difference of refractive index between the objects and the air which makes them nearly opaque from total internal reflection of the light results in foggy images and often totally obscures the structure. A medium of higher refractive index should be used for hyaline forms like diatoms, even higher than balsam for very thin forms. During mounting the organic matter is burned out by heating the cover-glass. During this process, some of the forms may be melted into the cover-glass. They may be observed profitably if the glass be made with the same refractive index as that of the front lense of the objective. A common accident to the mount is the running in of the cements but this accident sometimes changes the dry

mount to an immersion mount and thereby greatly improves it. It is, also, almost impossible to make a dry mount which will not deteriorate by deposit of moisture beneath the cover.

Meat Inspection.—The inspection of meat for interstate commerce was instituted in 1891, and now there are 128 abattoirs in 33 cities where the Government inspects all meat slaughtered. The number of live animals inspected in 1897 was as follows: Cattle, 8,250,025; sheep, 8,044,355; calves, 448,983; hogs, 25,566,744; total 42,310,107. Of these the following numbers were rejected: Cattle, 25,146; sheep, 11,260; calves, 2,653; hogs, 53,145; total condemned, 92,304. This last total does not show a large percentage of diseased animals in this country, but it is unpleasant to think that, without inspection, many of them would find their way onto the butcher's block; some would be condemned by State or municipal inspectors.

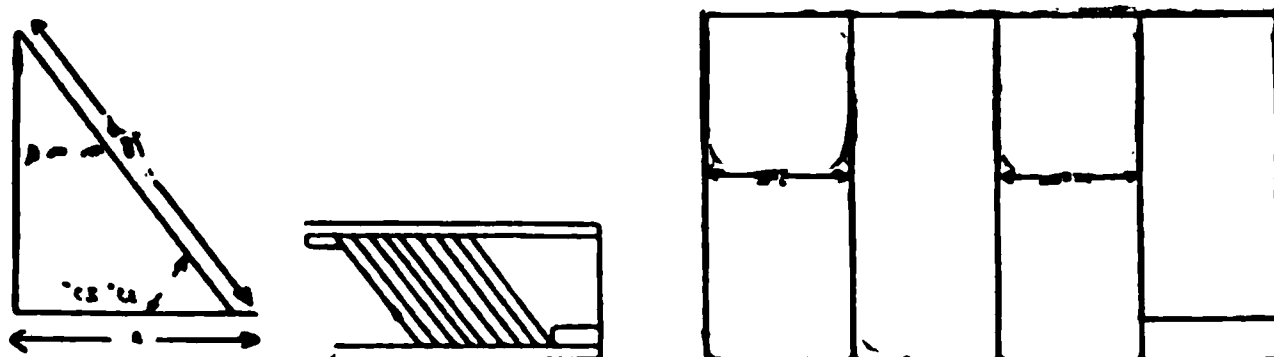
In addition to the above figures, there were post-mortem inspections of 26,580,689 animals, and 49,295 parts of carcasses were condemned. Besides, there were killed by city inspectors 641 cattle, 1,527 sheep, 40 calves, and 2,081 hogs that had been rejected in the stock yards by officers of the Bureau of Animal Industry.

Crystals in Paper.—It has been discovered that old paper, such as is found in old books, sometimes contains beautiful dendretic crystals. It is supposed that particles of brass or copper have fallen on the paper pulp and have been partly dissolved in the chemicals. The lapse of years permits crystalization. Twenty years is supposed to be required and a certain amount of dampness in the paper. The star-like cluster has a width of about 1 mm. and may be examined with a small lense or a low power objective. Dr. Shanks has recently found three of these forms upon linen paper whose age was not known. Thick and rather soft papers are most likely to contain them.

Personal.—Wm. F. Kuder is instructor in microscopy in the Cleveland School of Pharmacy.

SCIENCE-GOSSIP.

A Cheap Polariscopes.—The following cheap polariscopes will be found to give first-class results:—Cut 20 to 25 pieces of thin glass, 18mm by 12 mm. Now make a cardboard tube from a marked card, as shown below.



The pieces of glass should now be fixed in tube with strips of card shown in sketch. If all is done right, the glass will be at an angle of 35 degrees. Of course, two may be required. The square tube can be fastened in a round tube to fit the microscope.—*Eng. Mechanic.*

Carborundum Crystals.—The Physikalisch-Technische Reichsanstalt is now using carborundum crystals to a great extent to replace diamonds in the producing of finely divided scales. Small flat hexagonal crystals are chosen of from half to one mm. side and mounted in a steel holder by means of a drop of shellac. The lines are said to be much more even than those produced by a diamond; they have been examined when magnified fifty times and found to be still sharply defined.

Sheep Scab.—The disease commonly called sheep scab is the mange, or scabies, of the sheep. It is a contagious skin disease caused by a microscopic parasitic mite. This disease is one of the oldest known, most prevalent and most injurious maladies which affects this species of animals. It has been well known for many centuries, and references to it are found in the earlier writings, including the Bible, where we find, in Leviticus xxii: 22, the use of scabbed sheep forbidden in sacrifices. Some think that the mite which causes the disease was known to Aristotle, 322 B. C. The errors and uncertainties which came down

to us through centuries of controversy were finally and for all time dispelled by conclusive experiments upon animals made during the first half of this century. It was shown that scab does not develop and cannot be produced without the parasites. The complete life cycle of the mites was studied and demonstrated from the eggs to the adult parasites. It was shown that mites are always the offspring of ancestors, the same as are the larger animals, and it has in later years come to be admitted that there is no such thing known as spontaneous generation of any living thing under any circumstances. The demonstration was repeatedly made that the disease always developed if mites were taken from diseased sheep and placed upon healthy ones, and that diseases of the skin resembling scab are not contagious unless the mite is present.

The female mite lays about 15 to 24 eggs on the skin, or fastened to the wool near the skin; a six-legged larva is hatched; these larvæ cast their skin and become mature; the mites pair and the females lay their eggs, after which they die. The exact number of days required for each stage varies somewhat, according to the writings of different authors, a fact which is probably to be explained by individual variation, and by the conditions under which the observations and experiments were made. Thus Gerlach, in his well-known work (1857), estimates about fourteen to fifteen days as the period required for a generation of mites from the time of pairing to the maturity of the next generation. He divides this time as follows: Under ordinary conditions the eggs hatch in three to four days, although two authors allow ten to eleven days for the egg stage; three or four days after birth the six-legged larvæ moult and the fourth pair of legs appears; this fourth pair is always present when the mites are two-thirds the size of the adults; when seven to eight days old the mites are mature and ready to pair; several (three or four) days are allowed for pairing; another generation of eggs may be laid fourteen to fifteen days after the laying of the first generation of eggs. Without going into all of the other observations on these points, it may be remarked that the

eggs may not hatch for six or seven days ; the six-legged larvæ may moult when three to four days old, and become mature ; after pairing a second moult takes place, lasting four to five days ; a third moult follows immediately, then the eggs are laid and the adults die ; in some cases there is a fourth moult, but apparently without any further production of eggs. Accepting Gerlach's estimate of fifteen days as an average for each generation of 10 females and 5 males, in three months' time the sixth generation would appear and consist of about 1,000,000 females and 500,000 males.—*Bu. An. Industry.*

Intensity of Light.—At the Quekett Club Mr. Goodwin said that in trying some experiments with his little lamp, he tried to fill the field with light without using a bull's-eye condenser, and he had adopted a method of adding a small lens to the ordinary combination of the substage condenser. By this means he had been enabled to bring the lamp within three inches of the back combination of the substage condenser, and in this way he got a full field of light without in any way impairing the definition. He thought this plan worth the attention of those who desire to make the best use of their appliances.

Mr. Nelson said he had seen the contrivance and tried it and got one made for himself and though he had not exhaustively tested it he was assured of its merits. In the ordinary way the lamp must be put about 8 inches from the back of the lens of the condenser for best effects. His plan places a plano-convex lens of 5 inch focus in the screen holder of the condenser, which enables us to bring the lamp up closer—to 3 inches instead of 8 inches which is a matter of great importance when high powers are used. The idea is simple and capable of development.

Mounting Diatoms.—The best workers now use either Styrax, liquidambar or a mixture of balsam and monobromid of naphthalin. Moller, Thum and Tempere all use the latter a great deal, while Van Heurck prefers liquidambar.—D. B. Ward.

MISCELLANEOUS.

Bound Volumes.—We can supply copies of the Journal bound in neat cloth of every year from 1884 to 1897 inclusive. Price for a complete set of these 14 volumes in cloth binding and subscription for the current year \$20. Price of single volumes bound in cloth \$1.50 each.

For Exchange.—Pritchard's Infusoria illustrated with 306 figures: O'Mera's Diatomaceae with 46 figures, and many other works dealing with Microscopy offered in exchange for micro-rock sections, geological literature and other desiderata. Write to J. H. Cooke (Editor of Microscopy in "Science Gossip") Edleston, Battenhall, Worcester, England.

An Old Book.—Zahn's "Oculus Artificialis" was published in 1702. It contained among other things figures of a telescope-sight for a musket and a cannon with the legend: "Bombardæ et omni genere balistarum ac torbellicorum tubum opticem sive teliscopicum aptare, quo visus ac scopum exacte dirigi poterit." A sunshine recorder, "Organum heliocausticum" had the legend: "Horas luce sono tibi sphaerula vitret monstrat, ignis nil mirum coelicus urget opus." A series of mirrors for telescopes were called "Catoprico dioptica telescopica."

Books.—Micrographic Dictionary by Griffith & Henfry, 845 pages and 48 plates in 2 volumes offered for \$10.00 by Pierce & Zahn, Denver, Colo. Also Carpenter's Microscope for \$4.00; Harris' Insects Injurious to Vegetation for \$4.50; Strasburger's Microscopic Botany for \$1.50.

Books.—The Chemical and Micromineralogical Researches on the upper Cretaceous Zone of the south of England by William Fraser Hume, D. Sc., can be bought from Whitehead, Morris & Co., Ltd., 9 Fenchurch St., London.

Catalogue.—We have received the priced and illustrated catalogue of microscopes and apparatus for sale by Paul Thate, N. Eisasser-strause 52, Berlin, Germany. Our subscribers can obtain copies by mentioning the fact to Mr. Thate on postal card that they have seen this item.

Elmira, N. Y.—The society formerly existing in Elmira is now the Updegraff Microscopical Section of the Elmira Academy of Sciences.

Opticians.—On October 10th the American Association of Opticians was organized in New York City. It does not appear that microscopy will be covered at all by the new organization.

Osprey Plumes.—The feathers are stripped from birds in the breeding season, involving their death and the starvation of their young. Sir John Lubbock has secured their abolition from the British army.

Objective.—Leitz has made a 1-10 inch oil immersion objective with a numerical aperture of 1.3 the price of which is \$18.50 only and it is pronounced superb by highest authority. It is the first of the kind made for a long tube. Semi-apochromatic lenses have been brought up to almost equal apochromatic. The difference in aperture is in proportion of 13 to 14. Many of the more difficult objects can be resolved by them.

Reynolds and Branson's Microtome.—The instrument is arranged to slide on a glass plate with a circular roughened ring, the substance to be cut being imbedded and fixed on that plate. Sections of any degree of thickness may then be cut by simply raising or lowering the screw. The microtome is so arranged that any razor may be clamped to it, and it will be found extremely useful to students in physiology, botany etc. The price of the microtome, with glass plate, is only 4s., and razors are supplied at 1s. and 2s. each. Write to Reynolds and Branson, Leeds, England for full description.

Paraffin Imbedding Table.—It is made of a triangle of sheet copper, with a base of six inches and a perpendicular height of fourteen inches. The edges of the triangle are turned under and inward, giving to the table a smoothly rounded margin. In height, the main part of the table measures two inches, and it is four inches high under the apex of the triangle, where is placed the heating flame, which may be gas, or oil, or alcohol lamp.

**Gates' Double Microscope with Arc-lamp, Condensing and Parallelizing Lenses,
Alum Filter and Camera.**

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The Double Microscope.

It is now nearly a year since Professor Elmer Gates announced his success in photomicrography with two microscopes placed end to end. A large amount of frothy talk has emanated from a superannuated microscopical editor against the plan, and the English authorities have denounced the scheme. All these people have without exception contented themselves with denunciation or denial, and scorn to try even to repeat the experiments. The absolute stupidity of refusing to try the arrangement is laughable. No person has come forward to say: "I have given Gates' plan a full, fair, and honest trial and it is a failure for such and such reasons." Meanwhile the matter is taking shape. Some people who have repeated the experiments have reported success, including E. Gerber of the New York Microscopical Society. A business concern is now making a supply of microscopes containing two objectives as directed by Professor

Gates. He intends hereafter to use a heliostat instead of an arc-lamp.

In a recent letter to the editor of this journal he says: "I enclose a picture of the new double microscope (frontispiece). You understand that it is extremely difficult to keep the arc-lamp, the condensing lenses, the alum filter, the parallelizing lenses, the two microscopes and the

camera in alignment, and that when once focussed to secure a good definition that it is extremely difficult to adjust the camera so as not to throw the image out of focus.

"Fig. 1, is a photomicrograph of *Pleurosigma angulatum* made with a one-sixth inch objective and a one inch ocular in the first microscope and 14 millimeter objective and a one inch ocular in the second microscope. The definition in this particular photograph is bad but as

you will see, if you will take the trouble to call at my laboratory, the definition and detail can be strictly first class, but that with my present arrangements in not having all the parts upon the same bed-plate, it is almost impossible to adjust the camera without disarranging the focus. I have tried all of the usual test objects, such as the pygidium of a flea and the *Amphipleura pelucida*, and the usual test lines, and I can find nothing capable of being resolved with a 24th objective that I cannot much better resolve with a 6th inch objective in the first microscope and a half inch in the second. I submit that if this be true, and I will be very glad if you will call and see if it be true or not, we can place at the disposal of biologists a much cheaper and much more convenient and a much better microscope than the usual high power lenses."

I think I fully understand the influence of the cone of light admitted by the objective, and so on. Long before I commenced my recent microscopic experiments I made myself familiar with the subject, and I am prepared to show, in my laboratory, at any time, the resolving power of a half-inch objective on a sixth. With two such lenses, one inch ocular, and an arc light, I can show details in an object which cannot be shown with a 1-16th or a 1-25th! By using monochromatic light I avoid chromatic aberration, and I have no false images."

The authorities are all sceptical about this work because the idea is not new. Many men have many times unsuccessfully tried putting two microscopes together, but they have never had the necessary light nor the photographing apparatus attached. This combination constitutes the novelty of Professor Gates' arrangement and the intense light makes it effective.

Professor Gates published in the Popular Science News last December, a lengthy account of his work illustrated by: Photograph of the apparatus which magnifies 360,000

diameters; Pleurosigma with 2-3 inch objective; Pleurosigma magnified 450 diameters; Same, 1450 diameters; same, 6,000 diameters; same 10,000 diameters and same 360,000 diameters showing part of the lattice-work opening made by a sixth objective focussed on a sixth.

Description of the apparatus is as follows: "Upon the extreme left of the picture, and under the table are three resistance coils used to regulate the five-hundred volt alternating current with which my laboratory is supplied, so as to reduce it suitably for the arc lamp, shown at the extreme left upon the table. Next to the right are the condensing lenses, and then the alum filter with its bellows, and after that the lenses used to render the rays parallel. The revolving diaphragm is placed at the righthand end of the parallelizing lenses. Between the bellows of the filter-cell and the parallelizing lenses there is a screen holder, in which I place stained gelatin films to screen out such rays as may not be desirable. Beyond the revolving diaphragm the light next enters the sub-stage Abbe condenser and thence through the microscopic slide to the two microscopes and camera. The light is about 2,000 candle power and the results are extremely satisfactory.

In a slightly modified form of the same apparatus, the two microscopes are provided with tripple nose-pieces and projection lenses.

The complete form of the instrument now being manufactured, will consist of a solid brass bed-plate long enough to hold the entire system of apparatus, with means for adjusting the various parts from the rear of the camera. The entire system will be enclosed in a box capable of screening out all actinic rays. Dust and aqueous vapor particles will be removed from the interior of the instrument by a special device which need not here be described. I am having made a similar outfit from which I will have eliminated all the lenses which have

hitherto, been used for correcting chromatic aberration; also a new apparatus for furnishing parallel rays for monochromatic light of great intensity, and I am satisfied that ten million diameters can easily be photographed.

Can a second microscope be used to view the magnified result of a first microscope so as to give details which the lens of highest power would not give singly? It is necessary to prove this, because it is widely taught that to get greater magnification and *detail* than a given lens, say a one-sixth inch objective, we must use a smaller lens, for example an eighth-inch, and get nearer the object. That this is not true I can demonstrate.

If the widely accepted theory be true, the only way by which I can get a better magnification than with a one-twelfth inch objective is to use a 1-16th inch, with greater aperture because among other things no other lens would be smaller and nearer the object. But instead, I took a one-sixth inch objective for the *first* microscope, and a two-thirds inch objective for the second microscope, and focussed the objective of the second instrument upon the focal plane of the image in the ocular of the first instrument; the outer lens of the ocular having been removed, and then, to the ocular of the second instrument, I adjusted my photomicrographic camera, and the result was the magnification greater than a one-sixteenth inch lens, and more detail far beyond any 24th inch objective.

This proves that with two lenses low down in the series—a two-thirds and a sixth—I have obtained a better result than with an expensive sixteenth.

Then I tried a still lower lens in the second instrument—an inch lens—and a twelfth in the first instrument. I used shortest tube-lengths and two-inch oculars, and the result is the magnification is nearly 10,000 diameters.

So far I have demonstrated that better work can be done with low power lenses by using a double-microscope than with the highest power lenses, if but a single

microscope be used. This augurs well for the popularization of the study of the higher and more interesting domains of microscopy, because an instrument can now be constructed with a few cheap objectives capable of doing better work than has hitherto been possible with objectives costing twenty times as much. With a sixth-inch objective in the first microscope and a one-half inch in the second, I have resolved many markings and details in well-known microscopic objects that could not be resolved with the best sixteenth-inch apochromatic of high aperture.

When higher objectives than a sixth and a half are used the eye can no longer see the image, because of its faintness. But where the eye fails, the sensitive plate comes to our aid, and photographs the otherwise invisible image. The sensitive plate acts cumulatively and gathers into one concrete result the continuous action of the faint rays, for seconds and minutes of time, and thus records the higher magnifications.

A sixth on a sixth is probably the limit with an ordinary camera in an ordinary dark-room, and with ordinary photographic technique. Photomicrography has hitherto, so far as I know, obtained no results much beyond 10,000 diameters or 100,000,000 times the area of the original object. Any given detail in such a photomicrograph is made with the 1-100,000,000th the amount of light that comes from the corresponding part of the object observed. But I have succeeded in getting a picture with only 1-1300th of that amount of light.

In the photomicrographic apparatus now being constructed, I have arranged to exclude from the interiors of the microscopes and camera all dust particles and aqueous vapor globules. Then the light can act cumulatively hour after hour and day after day if necessary, and the photogenic changes made on the sensitive plate will result wholly from the action of the image. From

some tests already made I think I am safe in saying that owing to this device I shall be able to photograph with less than the one-tenthousandth part the intensity of light formerly considered necessary. This improvement is applicable to photography in general, but especially so to photomicrography. First by using the wider lenses of the double microscope, I photographed with the 1-1,300th the usual amount of light, thus making a magnification of 360,000 diameters or 129,000,000,000 times the *area* possible. Exclusion of dust particles promises to permit the use of a hundredth part of this latter amount of light, that is, it makes possible the photography of over *three and a half million diameters* or over 12,000,000,000,000 times the *area*.

But I found another source of trouble in the use of such very faint light, namely, the leakage of actinic rays through the wooden and leather walls of the camera and through the imperfectly-fitting sliding joints and connections of the microscopes. With reference to ordinary photomicrography this leakage is but a small percentage of the amount of light which reaches the sensitive plate, but when we get beyond a sixth-inch objective in the first microscope and a sixth-inch in the second, we are dealing with quantities of light much less than the amount of leakage in the best cameras probably ever before constructed. A sixth-inch objective can magnify, with proper oculars and tube-lengths, at least 600 diameters, which is an area of 360,000 times that of the object. Hence any point of the magnified image has only the one-three-hundred-sixty-thousandth the intensity of light of the corresponding part of the object. But when on this already faint part of the image I focus another sixth inch objective I still further spread that light over an area 360,000 greater and I get the 1-360,000th of the intensity of light with which such photomicrography has hitherto been accomplished, that is, I have the 1-360,-

000th of the 1-360,000th the amount of light coming from the corresponding part of the object.

If I use a one-twelfth in the first microscope and a sixth in the second, the magnification will be 2,000 times 600 diameters or 1,200,000 diameters which equals an area of 1,440,000,000,000 times that of the original object. This seems incredible, but I have already obtained evidence of being able to photograph a magnification of over three million diameters, or over twelve trillions of times the area. But if I mistake not, the limit is far beyond this, and that limit is one of photochemistry and not of photography as hitherto known. Beyond a certain point the rays will doubtless grow too weak to effect chemical changes. The energy may not be sufficient to decompose the molecule, no matter how long the ray acts. We do not know where that limit is, but it can be shown to be very far beyond three and a half million diameters.

If in addition to using the larger lenses of the double microscope and to the exclusion of dust and aqueous vapor, we also put the entire apparatus inside of an actinic-proof box, we still further extend this capacity to act with a fainter light. If only one-tenth less light can be used it will make possible ten-million diameters or one hundred trillion areas. If one-hundredth the amount of light can be used, then 100,000,000 diameters are possible. So far, I am quite sure of being able to effect more than 3,500,000 diameters; how much more we do not now know and that is what I am busy upon.

There is another source of leakage and interference that has not, so far as I know, been hitherto corrected, namely, that which occurs in and between the objective and the condenser. Light from all directions impinges upon the condenser, upon the glass-slide, upon the tissue being examined, upon the cover-glass, and upon the front surface of the objective, thus distorting and weakening

the rays from which the photographic effect is to be obtained. This produces a vast amount of useless interference of waves. I find that when I protect all those parts from light, a much better result is obtainable with a given amount of light. Hence in all cases where the light is transmitted through the object the use of such a light-shield from objective to condenser will still further extend the probable limit of magnification.

But there is a limit not so far away as that of the before mentioned photochemic sensitivity of light, namely, the destruction of the energy of those rays within the perfected camera by their mutual interference. This will probably place the practical limit somewhere between about ten million diameters and the much higher limit of photochemic sensibility.

By using monochromatic light this "interference" limit will be at a much higher magnification than with white light. If we could get light of only one wave length it would certainly be quite useful to the new microscope, but a narrow range of the best actinic portion of the spectrum will do much better than polychromatic light.

But monochromatic light is desirable for quite another reason: It enables a much greater amount of light to be concentrated upon the tissues being examined upon the slide without acting as a burning glass to destroy the object. Rays near the upper limit of the spectrum do not so rapidly heat an object as the lower rays or as white light. Hence I am arranging to focus the blue and violet and ultra-violet rays upon a large prism, parallelize them, and then transmit them through the objective. By starting with a large area of monochromatic light I hope to get a much greater intensity of light into the microscope than has hitherto been attempted. As far as I know I shall have at least one hundred times as much. This will extend the heretofore assigned limit of photomicrography.

Monochromatic light makes possible another important improvement. I do not mean the use of the well-known sub-stage spectroscopic attachment, but of large prisms in series so as to give a large area of actinic rays of one color, and then the focussing of these rays to a diameter several hundred or thousand times less, than making them parallel, and sending them into the substage condenser as you would a beam of sunlight from the heliostat. Such rays obviate the necessity for the usual additional lenses for correcting chromatic aberration. As is well known, the different colored rays come to a focus at different distances from the lens. In microscopes of the usual pattern it requires several lenses, in addition to the ones required for resolution and magnification, to correct this and make the rays come to one focus. If rays of one color are used only, then no corrections need be made for the rays of the colors not used. This requires less thickness of glass for the rays to pass through, and consequently the light will be stronger, and this again slightly extends the formerly assigned limits. As far as I know the microscope which I am now having built is the first *one that has been made especially for one-colored light*. It requires correction for only one color, and for spherical aberration, and this latter presents less difficulty for larger than for smaller lenses.

The first statement generally made by microscopists in discussing the new double microscope is one which affects profound pity for the man who could presume to do what has not been done before. This is generally coupled with the statement that every microscopist well knows, and has known for a long time, and that every beginner in microscopy ought to know, that if you produce more magnification than has hitherto been produced that you cannot see the image ; and that, therefore, my claims to a higher magnification are erroneous. Now the very gist

of my discovery consists in the fact that I have *not tried to see this image!* In fact, in all the articles that I have published on this subject I have stated that I had discovered how to make this image visible, and that I had succeeded in getting a magnification beyond that of former microscopes. I have stated over and over again that I have succeeded in getting a photograph with less than the one-thousandth part of the light that has hitherto been considered necessary. Beyond a sixth on a sixth, with one inch oculars, the image becomes so faint as to be scarcely visible. Now, when I use higher objectives, or when I place a third microscope in tandem with a double microscope, it is necessary to resort to a technic which enables me to photograph the invisible image thus produced. This technic consist in eliminating from within the camera and microscope tubes all traces of dust and aqueous vapor, and in enclosing the entire system of microscopes and camera within an actinic-proof box so that the rays which produce the image may act cumulatively. As a matter of fact, however, a magnification far beyond that of a 16th objective can easily be seen by the eye. The first statement that I made with regard to this discovery was that with a sixth inch objective in the first microscope and a two-third inch objective in the second microscope, and with a powerful source of light, such as an arc-lamp and parallelizing lenses, I could get more magnification and greater definition than with the 16th inch lens. As far as I have learned, whoever has tried this has admitted this statement. It is not a matter of argument, but of proof, and that proof I have on hand. I also said that by putting higher objectives in place of the ones just named I could get still greater magnification and detail, but that it would be necessary to photograph the image because it was *too faint* to be seen by the eye. I had one photograph in which the magnification was so great as to show the

irregularly opaque structure *between* the "lattice work" openings in the *Pleurosigma angulatum*. This is at least 300,000 diameters beyond that ever before achieved but I think this is but the beginning of the new field into which I have entered. A practical test exhibited to practical men led to the investment of sufficient capital to put this instrument upon a commercial basis, and such instruments will be upon the market as soon as all the details of manufacture can be arranged and patents obtained. The most important improvement beyond the ones just mentioned is that of making a microscope specially adapted to mono-chromatic light. This obviates the necessity of using lenses for chromatic aberration. The advantage is obvious. It makes not merely a cheaper microscope but it makes one in which the definition is improved. By using a large area of mono-chromatic light made by large quartz lenses, and then focussing this to a narrower beam rendered parallel by suitable lenses, I expect to get into the microscope from one hundred to one thousand times the amount of light that has ever been put into it before. If any one will take a Bausch and Lomb microscope, with a one inch ocular, and put in it a one-sixth inch Bausch and Lomb objective and focus it upon a pleurosigma, using a ray of condensed sunlight, because ordinary sunlight would not be intense enough, or using a powerful arc-lamp, with a sixth-inch condensing lens and bringing the beam down to one-quarter of an inch in diameter, and then parallelizing the rays, he will have the first part of the experiment complete. The definition will not be so good with an arc-lamp as with sunlight because it is impossible to have the arc-lamp rays entirely parallel. This owing to the fact that the light from an arc-lamp does not come from an absolute point, but from an area. If the experimenter will then remove the front lens of the ocular and adjust upon the focal plane of the image in the ocular a

two-thirds inch objective of a second microscope containing a one inch ocular, he will find, if his microscopes are in alignment, and if the foci are correctly adjusted, a better and larger image than can possibly be produced by a sixteenth inch objective. In fact, a magnification equal to the best twenty-four inch objective, and a field from ten to fifty times as large, and a depth from five to twenty times as great. It is useless for microscopists to deny this because I have the evidence in my laboratory. It is not a matter of discussion.

Can any one suppose that I would make these statements at random without having tried the experiments? And is it true that microscopists are willing to make criticisms without first having tried the experiments? It may not be known to some microscopists that recent progress in physics has been enormous, especially in the field of ether-dynamics. This progress makes it possible for me to predict that the very best microscopy will soon consist in using the invisible rays above the violet and of the spectrum for best results. I expect to see within a year a photograph made of the inner tissues of the body of a living person by means of photo-micrography, and ordinary photography with invisible rays. I do not mean a skiagraph, such as are produced by the \times -rays, but a photograph of the details of the surface of organs and of their inner structure. I have provided myself with a heliostat, made for me by the Societe de Genevoise. The mirror is 12 inches in diameter and it will throw a ray of sunlight into my microscope with considerable precision. This beam will be condensed into a beam at least one hundred times less in diameter and then rendered parallel and then thrown through the microscope either before or after having been rendered monochromatic by means of suitable prisms. A microscope made especially for mono-chromatic light will replace those of usual form. I am experimenting to get

lenses which will act upon the invisible rays in a manner the same as glass acts upon luminous rays. If I achieve success in this field I shall expect to obtain photographs of the interior of the body, and photomicrographs of interior tissues of the living body.—ELMER GATES.

Curious Leucocytes.

BY EPHRAIM CUTTER, M. D., NEW YORK.

(Tolles' 1-16th inch 180° objective, two inch ocular and B. stand, ten inch tube were used with the direct light of a small oil lamp, condensed direct with an one inch ocular.)
Mar. 16—A middle-aged man nervously complained of his tongue being over sensitive. It looked like an average tongue and the case was deemed to be neurasthenic. This opinion was sustained by the morphology of the urine presenting protoplasmic and filamentous catarrh, slight albumen, kidney casts and fatty epithelia. These were not continuously nor largely nor contemporaneously present but were disclosed at different times of examining the urine for about 20 successive days. The morphology of the saliva on top of the tongue showed the ordinary but overgrown papillæ distended with bacteria; epithelia invaded with spores; giant mucous corpuscles distended with granular but motionless contents, some with two or three nuclei. The ordinary automobile movements were not visible within. But curiously enough they were found in full activity within the leucocytes of the blood of the same case! The outlines and swarming changes of place of the intraspores were optically identical with those found in the oral mucous corpuscles! There were four or five of them, some with two nuclei and one with three. Some had amœboid movements. March 17, the oral mucous corpuscles were found with motionless contents. Also from active automobile swarming contents of leucocytes. On March 29th, the spores in the oral

mucous corpuscles were all active and the leucocytes presented no sign of them. It should be said that the blood serum presented on March 17, quite a number of automobile saltatory copper-colored spores which I have been taught by another observer to be syphilitic and which I have for many years found to be as reliable a sign as any other physical sign. I think the said intra leucocyte spores were syphilitic. I am not so sure of the intra mucous corpuscle spores, though the re-establishment of their motions after the cessation of the intra leucocytal movements is an exceedingly interesting chemical fact. Long ago was I taught by another observer that the swarming bodies in the oral mucous corpuscles were cryptogamous spores introduced from the outside in food and that a healthy baby nursing a healthy mother's breast has no such enlarged oral mucous corpuscles nor swarming molecular contents. I corroborate this. In the above case the abnormal morphology of the urine became normal and not long ago the patient returned to give thanks for his entire restoration to health. New York Oct. 24th, 1898.

Practical Suggestions.

By L. A. WILLSON,
CLEVELAND, OHIO.

LAKE ERIE WATER.—Gatherings from this lake are now especially full of *Melosira*, *Stephanodiscus*, *Ceratium*, *Daphnella*, *Pediastrum*, *Oscillatoria* and a host of smaller things. *Cyclops* is conspicuously absent from the gatherings. The latter appear in great abundance, in the spring. The gatherings exhibit a different fauna and flora almost every month. Why is this so?

CEPHALOZIA SULLIVANTII—This is one of the *Jungermaniaceæ*, the scale or liver mosses. It is the smallest of the species and one of the minutest plants visible to

the unassisted eye. It is rare and grows on rotten wood, generally amid a mass of black dirt. To properly see the plant it is necessary to soak for a long time the wood on which it grows and then to remove the specimen by the aid of a dissecting microscope.

PHYSCOMITRIUM IMMERSUM.—This is one of the Bryeraceæ, true mosses. The plant is so small that it makes a pretty mount for a two or one inch objective. It should be mounted so as to exhibit the leaves, with their marginal yellow cells, the male flowers on young plants, the calyptra and the immersed subglobose capsules.

DAPHNELLA TUCKERMANII.—This is a very strange animal. The genera belongs to the Anulosa Arthropoda, Crustacea, Cleodocera, a single eye, intestine simple, no black spot in front of the eye, Daphnidae, six pair of legs, 2x2 jointed branches of the antennae. The species was named by C. M. Vorce, in honor of a leading physician of Cleveland. The animal is a frequent denizen of the filterings of The Great Lakes, but is generally destroyed in the filter and is wholly disintegrated when pressed by a covered glass. It may generally be found floating on the surface of a gathering and should then be mounted in a rather deep cell for examination. In such a cell, filled with a dilute aqueous mixture of glycerine, it can be preserved indefinitely. It was figured in "The Microscope," some years ago. When examining filterings with a quarter inch objective, the fins of this animal are frequent and furnish a pretty and puzzling objects.

AMPHIGASTRIA.—In most liver mosses (Hepaticæ) there is frequently a third row of leaves on the under side of the stem called "under leaves" or Amphigastria. These strange leaves are always along the stem and generally in a different focus from the other leaves. They are of specific importance and are exceedingly interesting. The determination of their morphology and utility will be a valuable scientific achievement.

EDITORIAL.

Limitation.—There is a definite limit to microscopic vision. Abbe and Helmholtz attribute this to the nature of light for they despair of resolving lines closer together than the length of half a wave of light. The higher the magnification the smaller the speck that can come into the field of vision at once. In a magnification of 50 diameters the picture represents 1-8 inch of space; in 100 diameters, 1-16 inch; in 1,000 diameters, 1-150 of an inch which is too small to be at all visible to the naked eye. The germ within the nucleolus of a cell has a structure too minute to be seen by any microscope yet made. The human ovum is 1-120 inch in diameter and made up of a countless number of cells. The yolk which encloses the nucleus and its nucleolus within can be seen but not the structure of the latter.

Bacteria in Ground Water.—The readiness with which bacteria may be conveyed to wells in sub-surface water has been shown in some experiments made on the Rhine near Strasburg by Prof. E. Pfuhl. Two kinds of bacteria, neither occurring in the Rhine, were placed in a shallow pit nearly full of water and in one hour one species had passed through twenty-four feet of gravel to a second pit, the other species appearing in the second pit within two hours.

Quekett Club.—362nd meeting, October 21. Messrs. Beck exhibited a series of their new British students' model microscopes. Messrs. Watson showed their Fram microscope with sliding bar to the stage. George Massee described the growth, fructification and life-cycle of certain fungi which usually can be found in the foray in Epping Forest, but which this year were absent on account of the dryness. He showed colored diagrams, dry specimens from Kew herbarium and slides. It was announced that W. Bryce Scott of Ontario had sent a quantity of West India coral sand, and diatomaceous earth from Nova Scotia, North Atlantic Cable dredgings

in 2,300 fathoms, polycistina from Springfield estate, Barbados, etc. Mr. A. Earland had cleaned the forameniferal sand for distribution and would supply those desiring some. Thanks were voted to Messrs. Scott and Earland. On November 18, Mr. Harris will read a paper on organisms invading calcareous and other Organic Remains.

Washington Society.—At the regular monthly meeting held on November 8th at the rooms of Dr. Reyburn an abstract was presented of Foster's lecture on the Physical Basis of Psychical Events.

SCIENCE-GOSSIP.

Imbedding Lichens.—For many lichens a harder grade of paraffin must be used than for most vegetable structures. A mixture of hard and soft paraffin, which melts at about 60 degrees C., is recommended. Clear the specimens in pure xylol, and to this add small pieces of paraffin, keeping the dish warm at the same time both to increase the solvent power of the xylol and also gradually and finally to evaporate it all. By this means the material is slowly warmed and penetrated with paraffin. After remaining in melted paraffin absolutely free from xylol for three hours the subject may be imbedded. The sections should be very thin, and before cutting the block should be chilled to somewhat below 20 degrees C. The microtome knife must be very hard, sharp and rigid. Stain by any of the usual methods.—*Science Gossip*.

Photo-Micrography of Opaque Objects.—At a recent meeting of the Botanical Society of Edinburgh, Mr. R. A. Robertson, M. A., B. Sc., read a paper on "A New Method for the Photo-micrography of Opaque Stem Sections." One difficulty in making photo-micrographs from recent or fossil stem sections is the trouble of getting a sufficiently large section to bring out diagnostic features. Another is, that it is a difficult process to cut and grind and polish large sections of fossils for photography by transmitted light. Neither can one always get permission

to make sections of valuable museum specimens of recent and fossil woods. Mr. Robertson has found that by directly photographing the surface by means of a microphotographic apparatus, excellent pictures, giving all necessary histological details of the tissues can readily be obtained. The recent wood surfaces are planed with a steel plane, and if at all rough the surface is wet. Very careful focussing is necessary, so as to get equal illumination. An opaque focussing plate should be used for rough adjustment, but the final focussing must be done with a clear glass plate. The illumination was by means of a magnesium ribbon fed through a fixed tube and placed at an angle of 45 degrees and a distance of ten or twelve inches from the surface to be photographed. An exposure of about forty seconds with Ilford plates gave the best results.—*Science Gossip*.

Quick Method of Preparing Sections.—It is often desirable to prepare sections of soft tissues in a very short time. To those who are familiar with the collodion method the following suggestions by Mr. M. P. Thomas in the "Journal of Appeal Microscopy" will be helpful. Place the tissue at night in forty per cent alcohol in the dehydrating apparatus. Remove it at 7.30 the next morning. Leave until 10 o'clock in two per cent collodion. Then place in five per cent collodion until 11.45. Arrange on the cork and place in eighty per cent alcohol. The material will be ready to section at 1.30. A total of eighteen to nineteen hours covers the whole operation.

Nematodes for Microtome Sections.—The following methods of preparing nematodes for sectioning with the microtome has been used by Dr. Kaiser with much success. The main difficulty to be overcome is the curling up while being killed. To prevent this place the worm on a slide with a few drops of water. Over it place another slide and move it slowly to and fro. This movement causes the worm to straighten. As soon as the nematode assumes the desired position the fixing liquid is pipetted between the slides, the motion of the upper slide being continued until the worm is dead. By this method one can

obtain a specimen which is perfectly straight and round.

Sectioning Bolitic Grains.—Lay a glass slip on a metal plate and place it over a spirit lamp. Soften a drop of nearly dried balsam upon it with heat, and lay a small plate of mica on it so that it will become cemented to the glass. Upon the mica surface imbed in balsam and arrange the small objects of which sections are desired. When the balsam is cold and firm the glass is used as a handle by which to hold the objects whilst grinding. A flat surface may be given them as they lie in the balsam, by rubbing with a hone. Heat the glass to release the mica by softening the lower film of balsam, lift the mica with forceps and turn it over on another glass which has been provided with balsam. The ground glass is now downwards, and the other side may be ground as desired.

—*Science Gossip.*

MISCELLANEOUS.

Slides.—Geological specimens nicely mounted \$2.25 per dozen. Address: Micro., 34 Trederwen road, Dalston, N. E. London, England.

For Sale.—Fatty Ills and their Masquerades, By Ephraim Cutter, M. D. LL. D., and J. A. Cutter, B. Sc., M. D. \$1.00. Box 494, 120 Broadway, New York.

Personal.—F. E. Twining, Fresno, Cal., makes bacteriological investigations for the medical profession and others.

Desirable.—Mason, 69 Park road, Clapham, London offers two new sets lantern slides photographed from nature and especially fitted for public exhibition, 38 slides in each ; packed in box for \$8.50 each set ; 18 slides illustrating anatomy of honey bee \$4.25 ; 9 slides anatomy of blowfly \$2.10. He sends a sample slide for 30 cents post paid, or 18 miscellaneous specimens for 25 cents each. He has stem sections to illustrate distinct orders of plants, sections of cell contents, also reproduction. These with 12 special exhibition slides for \$2.75 post free.

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An Episode in the Artificial Culture of Diatoms.

BY WILLIAM A. TERRY,

BRISTOL, CONN.

Late in August, 1895, I made a gathering of sediment from the margin of a pond in Bristol at an elevation of some 800 feet. The water was low in the pond and had left this sediment uncovered for some time. The previous year I had made a similar gathering from the same place, and, on stirring it up in water found it very rich in desmids, numerous in variety and some of them very rare. This gathering contained also numerous varieties of desmids, but not in sufficient quantity to be easily separated from the mud. It had also diatoms, particularly *Surirelia biseriata*, and, as I believed it contained spores also I gave them a chance to develop. Stirring it up in water, after the sand and coarse debris had settled, I poured the lighter part into a glass dish about one

foot in diameter. The material formed a sediment about one-half inch deep with three inches of water over it, about one quart in all. I placed this in a cool room exposed to a strong light. In a few days a curious growth developed at points all over the sediment. This growth resembled a miniature moss, clubshaped, with a dark green top shading from pale green to light brown in the stem. Dozens of these peculiar growths appeared, about one-half inch in height and all very similar in form and coloring. The stem had no elasticity. When pressed carefully down it would remain on the bottom for some time but would finally rise up again upright. I pulled up one of these carefully with tweezers. The part below the mud was dark brown in color and resembled a root. Placing it on a slide under a one-inch coverglass, I found the green top to be composed wholly of desmids, magnificent specimens of *Microsterias radiosa* in all its various types with *M. furcata* and *M. americana* and many others, a dozen species of *Closterium*, as many of *Cosmarium*, with *Penium*, *Euastrum*, *Staurostrum*, *Dociidium* and many others, some of them unknown to me. All made up a rare collection of varieties which I had never before seen equaled. The stem was made of a tough mucous which contained small varieties of *Cosmarium*, *Penium* and *Euastrum*, but was chiefly filled with minute species of diatoms, *Navicula*, *Amphora*, *Nitzschia*, and a somewhat larger variety which from their darker color and slightly bellows shape I concluded to be developing *Surirella*. The root was composed chiefly of gelatinous hydrate of iron oxide. By the disturbance caused by the pressure of the cover-glass thousands of the diatoms were liberated and were rapidly traveling to and fro in all directions. These diatoms, were of well-known species, and most of them appeared to be destitute of silicex. I considered them immature forms.

As they were protected to some extent by their gela-

tinous matrix from the attacks of the Ciliata and Amœba, I hoped they would survive long enough to develop sufficiently to settle this question, and I watched them with great interest from day to day. That there should have been so many of these peculiar growths I thought remarkable. I had often before noticed the tendency of the desmids to climb upon projecting points, and probably the buoyancy given by the gases liberated by their vital processes was sufficient to stretch out the yielding gelatinous envelope of the diatoms into this shape.

Destructive animals did not appear very abundant. There were many rotifers but they live upon minute organisms circulating in the water. Around the root and climbing upon the stem of this growth under examination, I counted fifteen of those very curious sloth-like creatures, the Tardigrade or Water Bear. Some of these were very large, but, as the contents of their stomachs was colorless, they did not appear to have been feeding upon diatoms. Although I have watched these animals for a considerable time in hundreds of instances, I have never seen them feed. Notwithstanding, their formidable claws do not appear to me to be very destructive. Their comical contortions while painfully clambering over the debris look appealing rather than ferocious.

In a very few days it became evident that these growths were being rapidly devoured. Every morning a larger tract was cleared until finally all were gone. I then poured off the whole and strained it through a fine wire sieve, capturing a large number of that miserable crustacean, the aquatic representative of the common sow bug, a freshwater relative of the so-called sandflea of the seashore. This is the most omniverous destroyer I know. Fish, flesh and fowl come alike to him including animals, plants, vegetables, algæ, fungûs, desmids, and diatoms; and he will even devour their empty shells. During the three years that have passed since these oc-

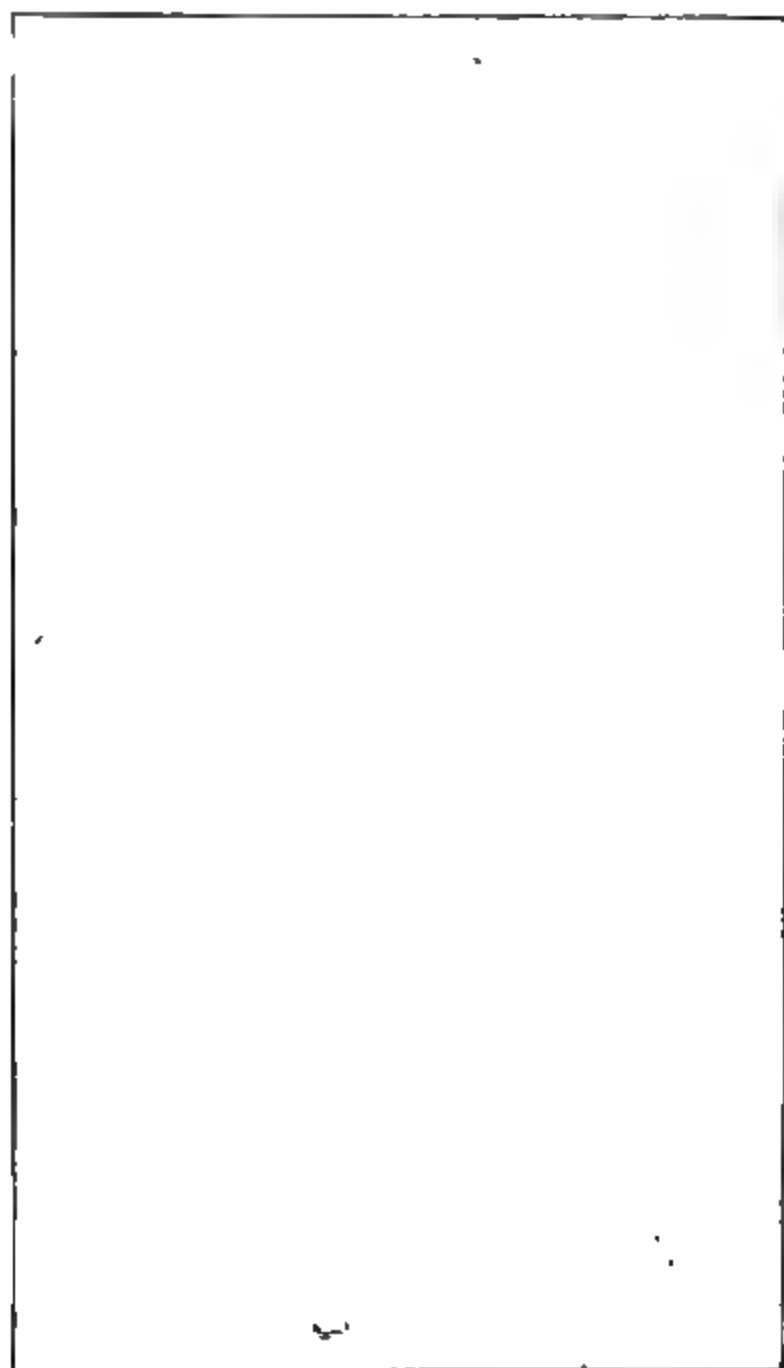
currences, frequent observations have been made, but no more of these peculiar growths have formed, although the material still contains living desmids and diatoms. Numerous colonies of minute diatoms enclosed in gelatine have formed but have not persisted long enough for conclusive results. A drop of the sediment now under observation shows six species of desmids, countless numbers of empty frustules of large *Surirella* and a few living ones, but their number has been constantly diminishing for a year past. A few specimens of *Surirella biseriata* still live but are very sluggish. *S. splendida* are nearly all dead, but active frustules of a very elongated type of *S. elegans* still survive. I wish those scientists who believe that the motions of the *Surirella* are confined to a "languid roll" could see one of these ploughing its way through the debris and crossing the entire field of the microscope in a little over one minute. Two or three species of *Pinnularia* also appear healthy.

A New Photo-Micrographic Apparatus.

A. W. BITTING, LAFAYETTE, IND.

The apparatus consists of an upright cast-iron post supported by three cast legs. The center of this post is bored out to receive the elevating post. Near the top is a sprocket wheel, which is turned by a screw and crank. A binding screw is also placed in the top to clamp the elevating post in position. The upright post, with its legs, stands 28 inches high. The elevating post is 28 inches long, is of two-inch steel tubing, turned to fit the hole in the upright post. A series of holes are drilled into the tubing to receive the sprocket wheel, which raises and lowers it. Upon top of the elevating post is a head-post which receives the bed plate for carrying the camera and microscope. The head-post is turned

to exactly fit the inside of the tube and permits the bed plate to be revolved on its horizontal axis. The bed plate is five feet long and five and one-half inches wide. It consists of a piece of three-sixteenths-inch rolled



steel, to which is riveted two dressed half-inch steel tubes. These tubes are placed near each edge and give rigidity as well as serve for guides for the camera and microscope carriages. In the centre of the bed plate is a rack for the adjustment of the camera and microscope

The attachment of the bed plate with the head post is by two dressed circular surfaces and a bolt. Upon the head post is mounted a screw which turns in threads cut upon the edge of the circular plate attached to the bed plate. By loosening the bolt and turning the crank upon the end of the screw the bed plate may be made to rotate upon its vertical axis.

The carriages are twelve inches long, grooved to fit upon the steel rods, and are provided with pinions, cranks and binding screws to make accurate adjustment. The stand is provided with castors so adjusted that it may be thrown on or off its legs with the foot. All the handles are nickel-plated and the whole apparatus enameled black.

The requisites of a good photo-micrographic apparatus are rigidity, ease and accuracy of adjustment and adapt-

ibility to all kinds of work. The first condition has been met by using metal in the construction, thus obviating shrinking, swelling and warping, inherent qualities of wood. The second and third requirements have been met in the mechanical construction.

With this apparatus it is possible to work in the vertical or horizontal position or at any inclination. The adjustment is easily and quickly made by loosening the binding nut between the friction plates and turning the bed plate to the desired position. The bed plate can be rotated on the horizontal axis to get the advantage of room and direction of light without moving the stand upon its legs. When the bed plate is turned to the horizontal the top of the bed plate is 33 inches from the floor; too low to work with comfort. By raising the elevating post the bed plate may be carried up to the height of five feet. This adjustment makes it possible to always have the work at a comfortable height, either in sitting or standing position, and regardless of the stature of the operator.

Diagnosing Yellow Fever.

In an official hand-book on yellow fever, its nature, diagnosis, treatment, and prophylaxis, which has just been prepared by the Surgeon-General's Office, Acting Assistant Surgeon John Guiteras says regarding the use of the microscope:

"An erroneous belief has prevailed throughout the South, especially among physicians who were not practical microscopists, that the microscope should be an important aid in diagnosis of yellow fever. It appears that poorly prepared abstracts from the work of Sanarelli have led many to believe that a characteristic feature, the bacillus of Sanarelli itself, was found on examination of the blood. Now the truth is, that even with the as-

sistance of post-mortem examinations, Sanarelli was able to discover his bacillus in only 58 per cent of the cases of yellow fever. He would be a poor clinician, indeed, who could only diagnose about one-half of the cases. The truth is, however, that during life the microscope could not establish a positive diagnosis. As far as our present methods go, it would be impossible to distinguish between a drop of yellow fever blood and blood from a healthy man. Negative evidence may be presented by the microscope. The presence of the plasmodium malarix, for instance, would prove that a case was suffering from malarial poisoning, and presumably not with yellow fever. But the differential diagnosis between these two diseases is usually easy. The billious remittent fever that in our old text-books of medicine occupied a conspicuous place in the tables of differential diagnosis with yellow fever, has practically disappeared from the Southern sea border since yellow fever ceased to be an endemic there. It was, in fact, the yellow fever of the natives and of places in the interior. The former were supposed to possess in a certain degree immunity against yellow fever, and the disease was believed to be restricted almost to the littoral. The plasmodium has been found in the blood in cases of yellow fever. The mistake made by the board of experts of New Orleans, when they failed to recognize the existence of yellow fever at Ocean Springs, was due to the finding of the plasmodium in at least two of the cases."

In February, 1896, Sanarelli discovered and named the *Bacillus icteroides* having found it in 58 per cent of the cases of yellow fever examined. Why could he not always find it? He states that in laboratory work these bacilli are quickly killed off by the common pus organisms, the colon bacillus and others. Having gained entrance to the circulation through the destruction of the natural barrier by degenerative changes brought by the

icteroides, these other organisms proceed at once to kill off the icteroides. By inoculation, Sanarelli produced a disease much resembling yellow fever, but the analogy was not so strong as desired. The symptoms and pathological changes differed sufficiently from those produced by other organisms to warrant the belief that the yellow fever was actually produced. Serum from convalescents or from yellow-fever cadavers produced only slight agglutination of the icteroides. Antidiphtheritic serum produces rapid agglutination of the bacillus, which would indicate a close biological relationship between it and the Klebs-Loeffler bacillus. There are points of resemblance in the manner in which the infection of yellow fever and diphtheria spread. Typhoid serum also produces this phenomenon but partially, and, as would be expected, colon serum and that from normal man produces no effect. Serum from a convalescent possesses no curative action in the guinea pig simultaneously with the minimum fatal dose of icteroides, but 2 c. c. of the same serum administered 24 hours previous to the minimum fatal dose seems to confer immunity,—at least, the pig does not die. A horse has been immunized to the icteroides and .5 c. c. of his serum will give to the guinea pig the immunity above mentioned under the same conditions, and even after 48 hours has been allowed to elapse, 2 c. c. will save the animal. Saranelli used the serum of a horse inoculated with gradually increasing quantities of the icteroides for 18 months. In Brazil, he treated 8 cases with subcutaneous injections, the total quantity varying from 15 c. c. to 65 c. c. with a mortality of two. Many able and conscientious investigators are still working to verify the researches of Sanarelli and it is hoped they will succeed at an early date.

Wolle's Diatomaceæ of North America with plates for sale cheap. Address the Editor.

Fixing Blood for Microscopic Study.

Complex technique in the preparation of microscopical preparations has done more to limit the use of the microscope in the diagnosis of disease than any other one thing. Take the ordinary directions for the preparation of a blood slide. First the most careful soaking and scrubbing of cover glasses, then the application of one of the glasses to the drop of blood, followed by a second cover glass laid over the drop and the two pulled slowly apart, with the result that in fully half of the cases neither of the two cover glasses is spread in any way suited to the purpose; either no blood adheres or the corpuscles are found overlying one another, or matted to such an extent as to make them worthless. Finally, if a good spread is secured, fortunate is the ordinary worker if he does not find, after following the advised heat method for fixing, that he has not fixed the corpuscles, but simply distorted them.

The following method of blood preparation requires only ordinary skill and presents the advantage of almost invariably giving first-class specimens. A solution is prepared which will mechanically separate the corpuscles of blood mixed with it, and yet of such density and composition as to permit them to retain their proper shape and condition. There are several such solutions. The formula suggested by Hayem is as follows:

Chloride of sodium.....	1 part.
Sulphate of soda.....	5 parts.
Bichloride of mercury.....	5 parts.
Distilled water.....	200 parts.

Drop a few drops—about five—of this solution in a small test tube or vial. Then after scrubbing the skin with alcohol or ether, puncture with a triangular surgeon's needle. With a small wire loop or a pointed glass rod quickly transfer a very small drop of blood from the

surface of the skin into the solution and stir thoroughly. Use a looped wire, similar to the platinum loop used in transferring sputum to a slide, but with the loop made smaller. Now the blood may be carried any distance without change. This is all that is necessary to do at the bedside, and the subsequent manipulations may be made at leisure. When it is desired to continue and complete the examination, a slide and cover glass are cleaned in the ordinary way, the mixture of blood and Hayem's fluid is stirred or shaken, and a small drop placed upon the slide. If a stained preparation is not desired, the mixture is covered with a cover glass and examined at once. It will be seen that all the corpuscles are separate, with no tendency to collect together, and not distorted.

If it is desired to prepare stained specimens, then after the small drop is placed upon the slide it is to be subjected to the following manipulations. The following solution is to be used :

Formaline 8 drops.

Alcohol 3 drachms.

A quantity equal to twice the bulk of the blood solution which had been placed upon the slide is now placed also upon the slide, so that the blood solution and formaline in alcohol solution shall come in contact by their sides. At once it will be noticed that the blood is being precipitated as a very fine white precipitate. The slide should now be left to lie perfectly flat for at least one minute, after which time fixation is complete.

Now the fluids may be allowed to evaporate slowly, or if it is desired to rapidly complete the process, small pieces of blotting paper may be applied to the edges of the fluid, and some of it cautiously absorbed, always watching the white precipitate to see that it is not also removed by the blotting paper. When but little of the fluid remains, gentle heat may, in my experience, be used

to facilitate drying without detriment to the specimen. The blood is now fixed to the slide, and may be stained in any way desired. When the formaline and blood solutions are brought in contact, a rather violent movement occurs, due to the difference in densities between the two liquids, and if the formaline solution is dropped directly upon the blood solution, the latter will be forced to the sides and the specimen will not be a uniform spread, but rather in the form of a ring, which, of course, is of no importance whatever.

Those who desire to make permanent mounts, and, desire neat-looking specimens, should mark out upon the slide a square, a little smaller than the cover glass, by taking a small camel's hair brush or a match and dipping it in collodion and marking out a hollow square. In the middle of this square I place the blood solution, and then the formaline solution, and unless the quantity of each is excessive, the fluids are accurately confined by this collodion wall during the mixing, and after the fluids have dried the collodion will easily peel off by using a pin leaving a specimen with sharp-cut edges.

There is no doubt as to the value of the alcohol formaline solution as a fixative for the corpuscles. A good smear may be made by dragging the slide its whole length over the drop of blood on the ear or finger-tip. Such smear may be at once set by pouring the formaline alcohol solution over the slide. After drying, the blood may be studied directly without cover glass, using an eighth objective. Wherever the smear is thin and well spread, abundant corpuscles will be found, which are not drawn out of shape or vacuated by the formaline-alcohol.

The great advantage of the Hayem's solution is that the blood may be kept for an indefinite time and examined at leisure. Ten minims of the salt solution should be put in a half-drachm vial and a small drop of blood added. After mixing with formaline-alcohol solution on

the slide, and drying, a confusing mass of needles and crystals are found mixed up with the scattered corpuscles. This crystalline debris, may be washed away by pure water gently dripped on the slide without disturbing the corpuscles. They may then be colored with the eosin and methyl blue solutions in succession, covered with cover glass, and examined with a twelfth oil-immersion at leisure.

The methods suggested may be tried by those accustomed to fixing blood with the alcohol-ether solution, or by heat, or by saturated alcohol sublimate solution, and the relative results compared.

For staining the malarial organism after fixing the blood corpuscles, the method is :

1. The specimens are stained with eosin (one-half of one per cent eosin in ordinary alcohol) for five to fifteen minutes ; the solution will not stain too deeply.

2. Wash in running water and dry in air.

3. Stain with methyl blue (one drachm of the laboratory solution to an ounce of water is strong enough), the time it takes to count ten—eight to ten seconds is long enough.

4. Wash in running water, dry, and mount in balsam. The blue stain colors the parasites : the danger is in over-staining with the blue. Good success is had by using a 10 per cent solution of methyl blue in alcohol, staining two or three minutes. But for the crescentic forms of the æstivo-autumnal fevers which stain with more difficulty than the ordinary forms of tertian type, the watery solution of blue is necessary.—*Ind. Med. Journal*.

For Sale.—A \$45 microscope stand for \$25. Address: W. A. Murrill, Ithaca, N. Y.

For Sale.—Fatty Ills and their Masquerades, By Ephraim Cutter, M. D. LL. D., and J. A. Cutter, B. Sc. M. D. \$1.00. Box 494, 120 Broadway, New York.

Practical Suggestions.

By L. A. WILLSON,

CLEVELAND, OHIO.

FLAGELLUM OF CERATIUM.—The flagellum of this animal when present is easily and plainly visible under an ordinary and inexpensive one-quarter-inch objective. It needs no staining nor a high angled expensive lens. The flagellum is seldom seen as the little animals are quite timid and at the slightest alarm retract this interesting appendage. It has been suggested that the animals pass into a "still condition" and in that state retract the flagellum.

FLAGELLUM OF BACTERIA.—These illusive organs may be plainly and comfortably viewed with a cheap one-fifth when properly stained. The difficulty in demonstrating these minute organs lies not with the lens but with the lack of skill and technical knowledge in the method of staining. To stain them requires experience, technical knowledge and special skill.

GUM FOR FIXING OBJECTS TO A SLIDE.—Selected pieces of gum arabic are dissolved in distilled water, so as to form a thin mucilage. This is filtered, and the filtrate poured into a considerable volume of alcohol, which precipitates the arabic. This is separated from the mother liquor by filtration, washed with alcohol and finally dried. It is freely soluble in water and can be used instead of the ordinary gum with advantage. It will obviate the granular appearance of the gum when used to fix objects to a slide.

BLACKENING THE INSIDE OF A DRAW-TUBE.—Many fine instruments are sold with the inside of the draw-tube covered by a bright metallic surface. With such an instrument it is impossible to obtain good photomicrographs or even to obtain a good definition. The following is a process for obtaining a dead black surface on

brass :—Put two grains of lamp-black into any smooth, shallow dish, add a little gold size and thoroughly mix the two together. Just enough gold size should be used to hold the lamp-black together. About three drops of size, as may be had by dipping the point of a lead pencil about half an inch into the gold size, will be right for the above quantity of lamp-black. After the above are thoroughly mixed and worked, add twenty-four drops of turpentine and again mix and work. Apply thin with a camel's hair brush, and when dry, a fine dead-black will result.

PRACTICE.—It requires considerable experience to interpret correctly the objects viewed in the field of a lens. It is generally impossible for a person unaccustomed to the instrument to know precisely what the field exhibits. When experts bring their instruments into court judges and jurors often take a look at an object and draw the most erroneous conclusions. Air bubbles, oil bubbles, stray debris and accidental particles are apt to most strongly engross the attention.

MUSCA DOMESTICA.—This is a common house-fly. On account of the conformation of its mouth parts, this insect cannot bite. Common and wide-spread as this species is, there is very general ignorance as to its life history and habits, except in its adult stage. Its length of life in the adult condition is not certainly known. In a warm climate it produces ten to thirteen generations every summer. A single fly will lay an average of one hundred and twenty eggs. Stables are their chief and favorite breeding places. They are carriers of contagion. In the autumn, they are attacked by minute reddish mites. As many as nineteen of these mites have been found on a single fly. Soak the fly in a shallow vessel in turpentine when the mites will crawl off and may be examined and mounted.

EDITORIAL.

Periodical.—It is unfortunate that the monthly, "Natural Science," is to lose its editor and perhaps its life with the end of the year, but while it lives it kicks, calling the Scientific American in its August number "an American Pirate," and accusing it of repeatedly stealing from the columns of Natural Science.

Cells.—At the late meeting of the British Association for advancement of Science, forty pounds (\$200) were appropriated for Prof. E. A. Schafer to use in research upon the micro-chemistry of cells.

Diagnosing Diphtheria.—Jaques urges early bacteriological examination in all anginas. In malignant cases make a direct diagnosis. Take a little of the mucous or of the membrane directly from the site of the invasion. Spread it on a cover-glass or slide, fix by heat, stain and examine. In other cases a culture should be made. Jaques has laid aside the laboratory test-tube and substituted a small metal culture box. Having inoculated it he carries it in the vest pocket where the heat of the body keeps up the proper temperature. After three or four hours he makes the examination.

Phyto-Plankton.—George Murray and V. H. Blackman have studied the nature and extent of the little understood microscopic objects called coccospheres and rhabdospheres. Their calcareous plates are described in minute detail. The coccospheres have a central green chromatophore which separates into two on the division of the cell. These plants belong to the unicellular algæ. They are found on the surface, in deep-sea deposits and in fossil beds.

Forest Leaves.—Microscopic observation of the living leaf reveals that the chlorophyll granules are individually independent globules of dense protoplasm, without proper walls, plunged in the midst of the fundamental protoplasm and tinged by the green matter, their form and size remaining unaltered when extracted by ether, etc.

SCIENCE-GOSSIP.

Decaying Pine Wood.—J. S Dales reports a peculiar condition in a tree box. The decayed portion did not present the usual dull, dark, shrunken appearance common to rotten wood. Above the line of moisture, it was of bright, buff color, glossy and velvety to the touch but, upon slight pressure it crumpled into powder leaving a small mass of coarse and hard wood-fibers. Microscopic examination revealed a dark interstitial fungus and a great abundance of minute spore-like bodies which resisted many of the usual staining fluids.

Nucleo-albumin.—For anæmia, Dr. E. D. Klots, 156 W. 48th street, New York, has given haemaboloids, half an ounce four times per day, with the result of increasing the haemaglobin in two months from 41 to 69 per cent, the red blood-copuscles in ratio of 198 to 364 with a corresponding return of health. In another case the haemaglobin increased from 38 to 63 per cent and the red blood copuscles in ratio of 164 to 341. Photomicrographs of he blood before and after treatment are shown in the N. Y. Med. Jour. of Nov. 12, 1898.

Circulation of Blood.—The standard method of examining the circulation is that of extending on a frog-plate the web between the toes of a frog's foot. As, however, most amateur microscopists find it difficult to obtain a frog when they require one, it might be of advantage to some of them to know that the tadpoles of the common frog form excellent substitutes during their embryonic state, and that in the thin expansion of the tail the circulation is exhibited to perfection. These tadpoles are easily obtained in almost any district, and may be kept in a small aquarium or fish globe, where they will be handy when required. The method of examination is very simple. The tadpole is caught and transferred to an ordinary slide, and a lump of loose wet cotton-wool is placed over it, holding it down fast to the slide, and leaving the tail free for observation. If there is any tendency to curl the tail up on to the

object-glass, an ordinary thin glass cover may be placed over it to keep the tail steady. The tadpole can be kept thus for an hour or more without any apparent discomfort, provided that the cotton-wool be kept moist. It might be mentioned that the tadpoles are of very little use for this object after the development of the legs, as the circulation then ceases, and the tail becomes opaque. I always use a one-inch objective and dark ground illumination.—*Lewis H. T. Chase in Science Gossip.*

Photo-micrography with High Powers.—In “Nature” Messrs. J. E. Barnard and T. A. B. Carver explain how they have overcome the difficulty experienced in photo-micrography with high powers and critical illumination, owing to the unequal intensity of the light emitted from the surface of incandescent limes, or the impossibility of controlling the electric arc so as to maintain a constant position and condition of the crater on the positive carbon. The latter difficulty has now been overcome by having a simple form of hand-feed apparatus, with a pinhole camera attached, through which an image of the carbon points is projected onto a ground-glass screen. With such a form of arc-lamp absolute “centration” of the light can be secured and maintained, without reference to the microscope, after the necessary position of the image of the arc on the screen of the pin-hole camera has been once obtained.

Effect of Different Media on Micro-organisms.—Professor Bitting has found by making ten exposures each of air, water and milk upon four different media (neutral agar agar, neutral glycerine agar, neutral beef gelatine and slightly acid wort gelatine) using some closed petri dishes all under like conditions, that agar agar gave the most bacteria and wort gelatine the most moulds. The average number of colonies of bacteria developed by ten tests of air was: On agar agar, 86; glycerine, 73; beef gelatine, 64; wort gelatine, 41. Ten tests of water gave the following number of colonies: Agar-agar, 2,370; glycerine agar, 2,260; beef gelatine, 1,470; wort gelatine, 480. Ten tests of milk gave the following

number of colonies; Agar agar, 7,967 ; glycerine agar, 11,207 ; beef gelatine, 7,416 ; wort gelatine, 1,700. Agar agar shows the highest number of colonies. The average number of moulds from air was as follows: On agar agar, 3, glycerine agar, 7 ; beef gelatine, 20 ; wort gelatine, 34. Ten tests of water gave: Agar agar, 12 ; glycerine agar 15 ; beef gelatine, 60 ; wort gelatine, 88. Ten tests of milk gave: On agar agar, 2 ; glycerine agar, 7 ; beef gelatine, 12 ; wort gelatine, 47. Wort gelatine showed the highest number of colonies of moulds. Hence, statements of the number of forms found, are of little value unless the media are taken into consideration.

RECENT PUBLICATIONS.

New Book.—The Microscopical Proof of a Curative Process in Tuberculosis, or the Reaction to Tuberculin Evincing by Blood Changes hitherto Unrecognized, by Chas. Denison, M. D., Denver, Colo.

Mushrooms.—The Asa Gray Bulletin for October is especially devoted to the Amanita and seeks to notice mosses, lichens and sedges.

Tumor of the Jaw.—In the transactions of the Manchester Microscopical Society for 1897 is a paper by Mr. Worstenholme on Botriomyces, a micro-organism that produces tumor of the jaw, chiefly in oxen. It was formerly known as osteo-sarcoma, a malignant cancer.

Algae.—A list of the Fresh water algæ of Queensland, has been issued by the government at Brisbane.

The Double Man.—This story reminds us of the novels of Bulwer, being filled with information of the sort that most men refuse to accept as truth and with recitals which most men declare to be imaginary. The very knowledge that most of all we shall sometime wish to have is covered under the false label of fiction. We now only amuse ourselves and forget the tale. Send fifty cents to Paul Tyner Denver, Colo., therefore and be amused with what he writes of man's powers in the occult realm.

Someday, when the non-material in us has evolved to higher planes and subordinated the material we shall find a higher use for this kind of literature than we make of it today.

MISCELLANEOUS.

For Sale.—A high-class microscope by a renowned English maker. High-angle objectives, 2-3, 1-6 and 1-12 oil imm. achromatic Abbe condenser, &c., &c. A bargain. Apply to Dr. Thomas, 222 Sansome St., San Francisco.

Dublin Society.—The Irish Microscopical club that has heretofore met at the residence of its members is to meet in the future at the rooms of the Royal Dublin Society.

Society.—The Hastemere Microscope and Natural History Society contains 452 members and has an annual income of \$350. Mr. Grant Allen, the president, urges upon its members to each select some one branch of Natural History and endeavor to contribute something thereupon to the society.

Personal.—Dr. C. T. Caldwell is professor of Microscopy and Histology in the Medical Department of the National University, Washington, D. C. Dr. Willam B. French is professor of Bacteriology in the same college. These branches are taught by lectures and laboratory work consisting in the preparation and examination of microscopic sections, the making of cultures and familiarity with bacteriological technique.

Personal.—Thomas King, one of the founders of the Microscopical Society of Glasgow, Scotland, which was founded in October, 1884, died Sept. 14, 1896. His biography has been published by the Natural History Society of Glasgow. From 1884 to 1896 he was an officer of the Microscopical Society, and being a skilled microscopist and having a thorough knowledge of vegetable tissues, as well as of lower plant forms he was able to read many valuable papers before the society.

Personal.—Dr. E. J. Lutz is Professor of Bacteriology in the Medico-chirurgical college of Kansas City, Mo.

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Bacteriology.

WILLIAM C. DOBSON, M. D.

BIOLOGY, chemistry, medicine and surgery, in the progress of their evolution, have contributed little by little to the growth of a new branch of learning whose subsequent development has been of inestimable importance to each. Indeed, bacteriology illustrates the old adage, "The child is father of the man," for while it is the offspring of the medicine of the past, it has established itself as the dictator of the medicine of the present and future, especially in the management of the infectious diseases.—*McFarland*.

In presenting this subject to our readers, we open with a brief history of bacteriology, as outlined by Joseph McFarland in his admirable work on Pathogenic Bacteria, published by W. B. Saunders of Philadelphia.

Our aim is not only to interest physicians, but also to stimulate microscopists to greater effort and research along these lines. Bacteriology is not only a highly important

branch of medicine, but also a subject of especial interest to the microscopist. Without the aid of the microscope, little, if anything would to-day be known of pathogenic organisms, in which case the study of infectious diseases would be materially impeded, and that progress so essential to medicine and surgery, hopelessly retarded.

THE DOCTRINE OF SPONTANEOUS GENERATION.

“Among the early Greeks we find that Anaximander (43d Olympiad, 610 B. C.) of Miletus held the theory that animals were formed from moisture. Empedocles of Agrigentum (450 B. C.) attributed to spontaneous generation all the living beings which he found peopling the earth.

Aristotle (B. C. 384) is not so general in his view of the subject, but asserts that “*sometimes* animals are formed in putrefying soil, sometimes in plants, and sometimes in the fluids of other animals.” Three centuries later, in his disquisition upon the Pythagorean philosophy, we find Ovid defending the same doctrine, while in the *Georgics* Virgil gives directions for the production of bees. Not only was the doctrine of spontaneous generation of life, current among the ancients, but we find it persisting through the Middle Ages, and descending to our own generation to be an accidental but important factor in the development of a new branch of science. In 1542, in his treatise called *De Subtilitate*, we find Cardan asserting that water engenders fishes, and that many animals spring from fermentation. Van Helmont gives special instructions for the artificial production of mice, and Kircher in his *Mundus Subterraneus* (chapter “De Panspermia Rerum”) describes and *actually figures* certain animals which were produced under his own eyes by the transforming influence of water on fragments of stems from different plants. About 1686, Francesco Redi seems to have been the first to doubt that the maggots familiar in putrid meat arose *de novo*. “Watching meat in its passage from freshness to decay, prior to the appearance of

maggots, he invariably observed flies buzzing around the meat and frequently alighting on it. The maggots, he said, might be the half-developed progeny of these flies.

Placing fresh meat in a jar covered with paper, he found that although the meat putrefied in the ordinary way, it never bred maggots, while meat in open jars soon swarmed with these organisms. For paper he substituted fine wire gauze, through which the odor of meat could arise.

Over it the flies buzzed, and on it they laid their eggs, but the meshes being too small to permit the eggs to fall through, no maggots generated in the meat; they were on the contrary hatched on the gauze.

By a series of such experiments Redi destroyed the belief in the spontaneous generation of maggots in meat, and with it many related beliefs."

In 1683, Anthony van Leeuwenhoek, justly called the "Father of microscopy," demonstrated the continuity of arteries and veins through intervening capillaries, thus affording ocular proof of Harvey's discovery of the circulation of the blood; discovered bacteria, seeing them first in saliva, discovered the rotifers, and first saw the little globules in yeast which Latour and Schwann subsequently proved to be plants.

Leeuwenhoek involuntarily reopened the old controversy about spontaneous generation, by bringing forward a new world, peopled by creatures of such minuteness as to suggest not only a close relationship to the ultimate molecules of matter, but an easy transition from them. In succeeding years the development of the compound microscope showed these minute organisms to exist in such numbers that putrescent infusions, both animal and vegetable, literally teemed with them, one drop of such a liquid furnishing a banquet for millions. Abbe Lazzaro Spallanzani (1777) filled flasks with organic infusions, sealed their necks, and, after subjecting their contents to the temperature of boiling water, placed them under con-

ditions favorable for the development of life, without however, being able to produce it. Spallanzani's critics, however, objected to his experiment on the ground that air is essential to life, and that in his flasks the air was excluded by the hermetically-sealed necks. Schulze (1836) set the objection aside by filling a flask only half full of distilled water, to which animal and vegetable matters were added, boiling the contents to destroy the vitality of any organisms which might already exist in them, then sucking daily into the flask a certain amount of air which had passed through a series of bulbs containing concentrated sulphuric acid, in which it was supposed that whatever germs of life the air might contain would be destroyed. This flask was kept from May to August; air was passed through it daily, yet without the development of any infusorial life. It must have been a remarkably germ-free atmosphere in which Schultze worked, for, as was shown by those who repeated his experiment, under the conditions that he regarded as certainly excluding all life, germs can readily enter with the air. The term "infusorial life" having been used here, it is well to observe that during all the early part of their recognized existence the bacteria were regarded as animal organisms and classed among the infusoria. Tyndall, stimulated by the work of Pasteur, conclusively proved that the micro-organismal germs were in the dust suspended in the atmosphere, not ubiquitous in their distribution.

His experiments were very ingenious and are of much interest. First preparing light wooden chambers, with one large glass window in the front and one smaller window in each side, he arranged a series of test-tubes in the bottom, half in and half out of the chamber, and a pipette in the top, working through a rubber diaphragm, so that when desired, the tubes, one by one could be filled through it. The chamber was first allowed to stand until all the contained dust had settled, and was then submitted to an

optical test to determine the purity of its atmosphere, a powerful ray of light being passed through the side windows. When viewed through the front window, this ray was visible as long as there were particles suspended in the atmosphere to reflect it. When the dust had completely settled and the light ray was invisible because of the purity of the atmosphere, the tubes were cautiously filled with urine, beef broth, and a variety of animal and vegetable broths, great care being taken that in the manipulation the pipette should not disturb the dust. Their contents were then boiled by submergence in a pan of hot brine placed beneath the chamber, in contact with the projecting ends of the tubes, and allowed to remain undisturbed for days, weeks or months. In nearly every case life failed to develop after the purity of the atmosphere was established.

The following extracts from Tyndall's work will illustrate how slowly the doctrine of spontaneous generation was abandoned: "At a meeting of the Pathological Society of London, held April 6, 1875, the 'germ theory' of disease was formally introduced as a subject for discussion, the debate being continued with great ability and earnestness at subsequent meetings.

The conference was attended by many distinguished medical men, some of whom were profoundly influenced by the arguments, and none of whom disputed the facts brought forward against the theory on that occasion." "The leader of the debate, and the most prominent speaker, was Dr. Bastian, to whom also fell the task of replying on all the questions raised." "The coexistence of bacteria and contagious disease was admitted; but, instead of considering these organisms as probably the essence, or an inseparable part of the essence, of the contagium, Dr. Bastian contended that *they were pathological products spontaneously generated in the body after it had been rendered diseased by the real contagium.*"

"The grouping of the ultimate particles of matter to form living organisms Dr. Bastian considered to be an operation as little requiring the action of antecedent life as their grouping to form any of the less complex chemical compounds." "Such opposition, must of course, stand or fall by the evidence which its supporter is able to produce, and accordingly Dr. Bastian appeals to the law and testimony of experiment as demonstrating the soundness of his view." "He seems quite aware of the gravity of the matter at hand; this is his deliberate and almost solemn appeal: "With the view of settling these questions, therefore, we may carefully prepare an infusion from some animal tissue, be it muscle, kidney or liver; we may place it in a flask whose neck is drawn out and narrowed in the blowpipe flame; we may boil the fluid, seal the vessel during ebullition, and, keeping it in a warm place, may await the result, as I have often done. After a variable time the previously heated fluid within the hermetically-sealed flask swarms more or less plentifully with bacteria and the allied organisms, even though the fluids have been much degraded in quality by exposure to the temperature of 212° F., and have in all probability been rendered far less prone to engender independent living units than the unheated fluids in the tissue would be. These somewhat lengthy quotations are of great interest, for they show exactly the state of the scientific mind at a period as recent as twenty-five years ago.

FERMENTATION AND PUTREFACTION.

As in the biologic world the generation of life was an all-absorbing problem, so in the world of chemistry the phenomena of fermentation and putrefaction were inexplicable so long as the nature of the ferments was not understood. Cagniard Latour and Schwann in the year 1837 succeeded in proving that the minute oval bodies which had been observed in yeast since the time of Leeuwen-

hoek were living organisms—vegetable forms—capable of growth.

While yeast was looked upon as an inert substance in the act of fermenting, it was impossible to understand how it could impart fermentation to other substances; but when it was learned by Latour that the essential element of yeast was a growing plant, the phenomenon became a perfectly natural consequence of life.

Not only the alcoholic, but also the acetic, lactic and butyric fermentations have been shown to result from the energy of low forms of vegetable life, chiefly bacterial in nature. Prejudice, however, prevented many chemists from accepting this view of the subject and Liebig strenuously adhered to his theory that fermentation was the result of internal molecular movement which a body in the course of decomposition communicates to other matter in which the elements are connected by a very feeble affinity. Pasteur was the first to declare and prove that fermentation is an ordinary chemie transformation of certain substances, taking place as the result of the action of living cells, and that the capacity to produce it resides in all animal and vegetable cells, though in varying degree. In 1862, he published a paper "On the Organized Corpuscles existing in the Atmosphere," in which he showed that many of the floating particles which he had been able to collect from the atmosphere of his laboratory were organized bodies. If these were planted in sterile infusions, abundant crops of micro-organisms were obtainable. By the use of more refined methods he repeated the experiments of others, and showed clearly that "the cause which communicated life to his infusions came from the air, but was not evenly distributed through it." Three years later he showed that the organized corpuscles which he had found in the air were the spores or seeds of minute plants, and that many of them possessed the property of withstanding the temperature of boiling wa-

ter—a property which explained the peculiar results of many previous experimenters, who failed to prevent the development of life in boiled liquids enclosed in hermetically-sealed flasks. Chevreul and Pasteur (about 1836) proved that animal solids did not putrefy or decompose if kept free from the access of germs, and thus suggested to surgeons that the putrefaction which occurred in wounds was due rather to the entrance of something from without, than to some change within.

The deadly nature of the discharges from these wounds had been shown in a rough manner by Gaspard as early as 1822, by injecting some of the material into the veins of animals.

THE STUDY OF THE INFECTIOUS DISEASES.

Probably the first writing in which the direct relationship between micro-organisms and disease is indicated is that by Varro, which says: “It is also to be noticed, if there be any marshy places, that certain minute animals breed there which are invisible to the eye, and yet, getting into the system through mouth and nostrils, come serious disorders (diseases which are difficult to treat)” —a doctrine which, as Prof. Lamberton, to whom I am indebted for the extract, points out, is handed down to us from “the days of Cicero and Cæsar,” yet corresponds closely to the ideas of malaria which we entertain at present.

Surgical methods of treatment depending for their success upon exclusion of the air, and of course, incidentally if unknowingly, exclusion of bacteria, seem to have been practiced quite early. Theodoric of Bologna about 1260 taught that the action of the air upon wounds induced a pathologic condition predisposing to suppuration. He also treated wounds with hot wine fomentations. The wine was feebly antiseptic, kept the surface free from bacteria, and the treatment was, in consequence, a modification of what in later centuries formed antiseptic surgery.

Henri de Mondeville in 1306 went even further than Theodoric, whom he followed, and taught the necessity of bringing the edges of a wound together, covered it with an exclusive plaster compounded of turpentine, resin and wax, and then applied the hot wine fomentation. In 1671 Kircher wrote a book in which he expressed the opinion that puerperal purpura, measles and various other fevers were the result of a putrefaction caused by worms or animalculæ. His opinions were thought by his contemporaries to be founded upon too little evidence, and were not received.

Plencig of Vienna became convinced that there was an undoubted connection between microscopic animalcules exhibited by the microscope and the origin of disease, and advanced this opinion as early as 1782.

Unfortunately, the opinions of Plencig seem not to have been accepted by others, and were soon forgotten. In 1704 John Colboch described "a new and secret method of treating wounds by which healing took place quickly, without inflammation or suppuration." Boehm succeeded in 1838 in demonstrating the occurrence of yeast plants in the stools of cholera, and conjectured that the process of fermentation was concerned in the causation of that disease.

In 1840, Henle determined that the cause of infectious diseases was to be sought for in minute living organisms or fungi. He may be looked upon as the real propounder of the *Germ Theory of Disease*, for he not only collected facts and expressed opinions, but also investigated the subject ably. The requirements which he formulated in order that the theory might be proved were so severe that he was never able to attain to them with the crude methods at his disposal. They were so ably elaborated, however, that in after years they were again postulated by Koch, and it is only by strict conformity with them that the definite relationship between bacteria and disease has

been determined. Briefly summarized the requirements are as follows :

1. A specific micro-organism must be constantly associated with the disease.

2. It must be isolated and studied apart from the disease.

3. When introduced into healthy animals it must produce the disease.

Pollender (1849) and Davaine (1850) succeeded in demonstrating the presence of the anthrax bacillus in the blood of animals suffering from and dead of that disease. Several years later (1863), Davaine, having made numerous inoculation-experiments, demonstrated that this bacillus was the *materies morbi* of the disease. The bacillus of anthrax was probably the first bacterium shown to be specific for a disease. Being a very large bacillus and a strong vegetative organism, its growth was easily observed, while the disease was one readily communicated to animals for experimental purposes. In 1873 Obermeier observed that actively motile flexible spiral organisms were present in large numbers in the blood of patients in the febrile stages of relapsing fever. Klebs who was one of the pioneers of the germ theory, published in 1872, his work upon septicemia and pyemia, in which he expressed himself convinced that the causes of these diseases must come from without the body, Billroth strongly opposed such an idea, asserting that fungi had no especial importance either in the processes of disease or in those of decomposition, but that, existing everywhere in the air, they rapidly developed in the body as soon as through putrefaction a "Faulnisszymoid," or through inflammation a "phlogistischezymoid," supplying the necessary feeding grounds, was produced. In 1875 the number of scientific men who had entirely abandoned the doctrine of spontaneous generation and embraced the germ theory of disease was small and most of those who accepted it were

experimenters. A great majority of medical men either believed, like Billroth, that the presence of fungi where decomposition was in progress was an accidental result of their universal distribution, or, being still more conservative, retained the old unquestioning faith that the bacteria, whose presence in putrescent wounds as well as in the artificially prepared media was unquestionable, were spontaneously generated there. Before many of the important bacteria had been discovered, and while ideas upon the relation of micro-organisms to disease were most crude, there were suggested some practical applications that produced greater agitation and incited more observation and experimentation than anything suggested in surgery since the introduction of anaesthetics—namely, *antisepsis*. "It is to one of old Scotia's sons, Sir Joseph Lister, that the everlasting gratitude of the world is due for the knowledge we possess in regard to the relation existing between micro-organisms and inflammation and suppuration, and the power to render wounds aseptic through the action of germicidal substances." Lister, convinced that inflammation and suppuration were due to the entrance of germs from the air, instruments, fingers, etc., into wounds, suggested the employment of carbolic acid for the purpose of keeping sterile the hands of the operator, the skin of the patient, the surface of the wound, and the instruments used. He finally concluded an operation by a protective dressing to exclude the entrance of germs at a subsequent period. Listerism originated in 1875, and when Koch published his famous work on the *Wundinfektionskrankheiten*, (or traumatic infectious diseases), in 1878, it spread slowly at first, but surely in the end, to all departments of surgery and obstetrics.

From time to time, as the need for them was realized, the genius of the investigators provided devices which materially aided them in this work. Some of these have been indispensable throughout all subsequent investiga-

tions and have made possible many discoveries that must otherwise have failed. Among them may be mentioned the improvement of the compound microscope, the use of sterilized culture-fluids by Pasteur, the introduction of solid culture-media and the isolation methods by Koch, the use of the cotton plug by Schroeder and van Dusch, and the introduction of the anilin dyes by Weigert. It is interesting to note that after the discovery of the anthrax bacillus by Pollender and Davaine in 1849 there was a prolonged period during which no important pathogenic organisms were discovered, but during which the technic was being elaborated. This was again followed by a period during which important additions followed each other in rapid succession.

Thus, in 1873, Obermeier discovered the *Spirillum Obermeiri* of relapsing fever.

In 1879, Hansen announced the discovery of bacilli in the cells of leprous nodules. The same year Neisser discovered the gonococcus to be specific for gonorrhoea.

In 1880, the bacillus of typhoid fever was first observed by Eberth, and independently by Koch.

In 1880, Pasteur published his work upon "Chicken-cholera." In the same year Sternberg described the pneumococcus, calling it the *Micrococcus Pasteur*.

In 1882, Koch made himself immortal by his discovery of and work upon the tubercle bacillus. The same year Pasteur published a work upon *Rouget du Porc*, and Löffler and Schultz reported the discovery of the bacillus of glanders.

In 1884, Koch reported the discovery of the "comma bacillus," the cause of cholera, and in the same year Löffler discovered the diphtheria bacillus, and Nicolaier the tetanus bacillus.

In 1892, Canon and Pfeiffer discovered the bacillus of influenza.

In 1894, Yersin and Kitasato independently isolated the

bacillus causing the bubonic plague then prevalent in Hong-Kong.

In 1894, Sanarelli discovered the bacillus icteroides, thought to be specific for yellow fever.

A new era in bacteriology, and probably the most triumphant result of the modern scientific study of disease, was inaugurated by Behring, who presented to the world the "Blood-serum therapy," and showed as the result of prolonged, elaborate and profound study of the subject of immunity, that in the blood of animals with acquired immunity to certain diseases (diphtheria and tetanus) a substance was held in solution which was potent to save the lives of other animals suffering from the same diseases."

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

TO MAKE GLASS CELLS FOR MICROSCOPE SLIDES.—There are several methods for making glass cells for slides of insects, samples of ore, etc., each more or less convenient, according to the depth of the proposed cell. For cells from one-tenth inch in depth and upward, we have found the plan of cutting a ring off a bit of soft glass tubing, the easiest and best. This is done very quickly and surely by running a diamond pencil around the tubing at the required distance from the end, and touching the line thus made with the point of a red-hot poker or iron rod. To run the line smoothly and evenly, make a little supporter for the tube by nailing a couple of upright strips, notched at the top in V shape, to a wooden block, six inches long. Let the tube rest in the notches, apply the diamond firmly to the glass, and revolve the tube slowly, away from the person. A little practice will enable one to make a clean-cut scratch entirely around the tubing. In the absence of the diamond, a little slitting file may be used.

After the ring is removed, smooth the edges by grinding with emery powder on a leaden plate. For shallow cells, an

ordinary cover-glass may be used, by cementing it to a metallic ring of proper size, and when firmly fixed, punch a hole through the center. Smooth the edge of the hole with a round file. Small irregularities will not be visible when the cell is filled with mounting medium. Another plan is to wet the cover-glass with a little saliva, and press it down on the center of the turn-table. Set the plate to revolving, and touch the surface of the glass with a writing diamond. With a little practice, this is by far the neatest and most expeditious way.—*National Druggist*.

NUMBER OF SPECIES OF PLANTS.—Professor S. H. Vines, in his opening address to the Botanical Section of the British Association at Bradford, gave some interesting figures as to the number of species of plants at present known. The figures may be tabulated as follows :

SPECIES OF PLANTS.

Phanerogams	{	Dicotyledons	78,200	
		Monocotyledons	19,600	
		Gymnosperms	2,420	
	{		<hr/>	
		Subsequent additions	100,220 5,011	
			<hr/>	105,231
Pteridophyta	{	Filicinae (including Isoetes)		
		about.	3,000	
		Lycopodinae, about	432	
		Equisitinae about	20	
			<hr/>	3,452
Bryophyta	{	Musci	4,609	
		Hepaticae	3,041	
			<hr/>	7,650
Thallophyta	{	Fungi, (including Bacteria)	39,663	
		Lichens	5,600	
		Algæ (including 6000 Diatoms)	14,000	
			<hr/>	59,263

Making a grand total of 175,596
which, when compared with the 10,000 species of plants known

to Linnaeus in the latter half of the last century, show how vast have been our additions to the knowledge of plants. The amount of work for microscopists especially in the latter sections, appears to be unlimited.

PRESERVATION OF MEDUSÆ.—Medusæ should be killed by adding a few drops of concentrated chromic acid to sea-water containing them. Then well wash in sea-water until the chromic acid has disappeared.

Gradually add glycerin and alcohol to water, until objects are in pure glycerin and alcohol of same specific gravity as sea-water.

FRESHWATER ENTOMOSTRACHA.—Mr. D. J. Scourfield, in the Proceedings of the South London Entomological and Natural History Society, calls attention to the value of Entomostracha in experimental biology. "Their commonness in all parts of the country, their transparency, the ease with which they can be isolated and reared under all sorts of conditions, mark out the Entomostracha as particularly well fitted for observation in connection with even the most fundamental biological problems of the day." He adds: "We badly want detailed studies on local faunas, on the seasonal distribution and variation of different species, on the faunas of various types of ponds, on the food of the most abundant forms, and many similar subjects."

CAUSES OF FRACTURE OF STEEL RAILS.—The value of the microscopical examination of steel will be brought prominently before the general public by the recently issued report of the Board of Trade committee appointed to examine into the cause of fracture of a steel rail at St. Neot's station on Dec. 10, 1895, by which a serious accident happened to the down Scotch express. The report itself, dealing as it does with various experimental work undertaken by well-known experts, is somewhat inconclusive, but the microscopic examination by Sir William Roberts-Austen gave results of the utmost interest and value, Briefly stated, it may

be said that, according to this eminent authority, good rail steel consists of "ferrite," or iron free from carbon, and "pearlite," which is a mixture of alternate bands of ferrite and "cementite," the carbide corresponding to the formula Fe_3C .

The well developed pearlite with a conspicuous banded structure is readily shown microscopically, and is characteristic of good rail steel. When, however, steel is hardened by "quenching," pearlite is absent, and "martensite," which consists of interlacing crystalline fibres without banded structure, takes its place. Sir William Roberts-Austen says that "the presence of martensite in a rail should at once cause it to be viewed with extreme suspicion, as showing that the rail is too hard locally to be safe in use." The broken rail at St. Neot's showed an outside layer of martensite one hundredth of an inch thick. The report deals further with minute cracks found in this and other rails, and the enormous increase in liability to fracture occasioned thereby, and one conclusion drawn is that patches of martensite can be produced in a rail, when in use, by local treating caused by skidding, followed by the rapid extraction of heat by the cold rail. It is thus evident that the microscope will prove to be an increasingly valuable means of studying the complex structure of steel. For this purpose and for the examination of alloys it is used, and already a quite voluminous literature is growing up around the subject.

The Compound Microscope in Pharmacy.

ALBERT SCHNEIDER, M. D., Ph., D.

Compound Microscopes with objectives and oculars fairly well corrected for spherical and chromatic aberration, have been in use for nearly seventy-years, but it is only recently that they have been extensively employed in pharmaceutical practice. This is due to the fact that pharmacy as a science is of recent origin; only within the last decade have the courses of instruction in the colleges of pharmacy been based upon scientific principles—at least

this applies to the department of botany and its various branches, as vegetable materia-medica, vegetable pharmacography and powdered vegetable drugs. The leaders in pharmaceutical education admit that a good compound microscope is a part of the necessary equipment of the intelligent, competent, practicing pharmacist. It is, therefore, much to be regretted that there are a number of so-called colleges of pharmacy from which students are graduated, who have never used or even seen a compound microscope.

Such graduates are wholly unfit for the duties of a modern pharmacist, because it is only through the intelligent use of this instrument that he is enabled to vouch for the purity of most of the vegetable drugs and many other substances used in his practice. The advanced workers in Pharmaceutical Vegetable Histology abroad, as well as in this country, have employed the microscope for a number of years. A few eminent specialists of Germany and France have studied the histology of medicinal plants since 1825. The earlier German investigators also devoted much of their attention to the microscopical examination of foods and spices, textile fabrics and various other commercial products. Some of this work was really herculean, and it would be highly interesting to enter into a fuller discussion, but space will not permit. According to Pocklington, the use of the compound microscope in English pharmacy, dates from 1850, when Dr. Hassell laid before the Botanical Society of London, a paper on the histology of coffee and its adulterants. The microscope was introduced into American pharmacy a few years later. In England, as well as in the United States, the use of the compound microscope in pharmaceutical practice progressed very slowly, until about 1880 or a few years later, in spite of the earnest recommendation of a few leading teachers and investigators. Since 1880, some very energetic work has been done in America. Many of the

investigations are, however, defective, and a mere repetition of the work already done in Continental Europe, particularly in Germany.

It is much to be regretted that the truly scientific spirit does not permeate the English-speaking nations. The great majority of the scientific work done is primarily instigated and abetted by commercialism and hence does not attain to the lasting, far reaching results of the work of our patient and careful German investigators whose prime motive is to find out. In 1853, Dr. F. Hoffmann recommended the use of the compound microscope in American pharmacy, calling attention to the value of this instrument in the examination of vegetable drugs and their adulterants.

It was, however, not until some thirty years later that the compound microscope was used to any considerable extent in the study of vegetable drugs. It was looked upon as an impracticable instrument, having no commercial significance, and presenting no advantages over the simple microscope. Now and then some teacher or investigator would arise and reiterate the recommendations of Dr. Hoffman, or present some new phase of microscopic work in pharmacy, only to be met with the same indifference, if not actual opposition and ridicule. It is, therefore, little wonder that slow progress should have been made in the histologic study of medicinal plants. In Germany the compound microscope found a steady use in pharmaceutical practice. In 1865, Berg published his excellent atlas illustrating the histology of the more important vegetable drugs, and even at this date there is nothing produced by an English or American investigator which equals this work.—*Meyer Brothers Druggist*.

Formaldehyde.—It is put into milk for a preservative. Five tests for its detection are reported by Herman Harms in the Bulletin of Pharmacy, Detroit, Mich. Send 10 cents for the August number of 1900.

Extracts From English Postal Microscopical
Society Note Books.

WILLIAM H. BURBIDGE.

Polyp of Alcyonium palmatum. One of the Anthozoa, is of a higher organization than Hydroida. It is the cream colored, fleshy substance commonly called dead men's fingers. The protruded polyp is an elevated tubular column of translucent substance terminating in an expanded flower of eight slender-pointed petals—the tentacles of the polyp. "The spicules in this creature are of interest, being of varying forms. In *Alcyonium* the sexes are separate, and even the sexes of different colonies are distinct. In any one commonwealth the individuals are either all males or else all females.

The ova and sperm masses are borne on stalked capsules upon the free edges of the mesenteries, or straight bands that run down the tube below the curled up filaments, and development takes place outside the parent.

The embryos are free, swimming by cilia. They soon fix themselves and by continued budding produce colonies." (Hornell.)

STALKED LARVA OF ANTEDON.—This is better known by the name of *Comatula Rosacea*, or "feather-star." Mr. Hornell, in his "Journal of Marine Zoology," describes the delight with which he first pulled up, on a lobster-pot, a colony of this most lovely of star-fishes. I can also recall a red-letter day long ago when I pulled up in a dredge a mass of these beauties in Tar bay, one of the greatest prizes, I think, round our English coast. Its body consists of a disc some half inch across, from which proceed ten long slender arms, bearing numerous pinnules on either side. These often reach $3\frac{1}{2}$ inches, so that the creature has a span of 7 inches.

The sexes are separate, and the genital organs are situated not in the body disc, but in the tiny pinnules of the

arms. The fertilized ova are set free as barrel-shaped embryos which acquire four encircling bands of cilia. Next appear a few minute calcareous plates within this embryo, forming as it were, a tiny cask set upon a tiny stalk.

Free swimming life being now almost ended, a disc containing a perforated plate appears on the lower extremity of the stalk; and by this attachment is made to any object that happens to be in the way. The soft, barrel-shaped mass of the swimming larva has now shrunk and adapted itself to the form of the enclosed calcareous skeleton, and the creature is fairly launched upon the stalked and anchored period of its life. In this stage the skeleton is made up of a basal plate, rooting the animal to its host, a considerable number of joints set end to end forming a stalk upon which is seated the cup-shaped frame-work of the body, consisting of two circles of large perforated plates, respectively the "basals" and "orals."

The former form the base of the cup, and the latter the upper ones. Growth after this is rapid; other circles of plates appear, the ten arms proceed from one of the circles, the top joint enlarges into a plate-like structure and develops claw-like jointed organs, the cirri. The body breaks off from its stalk and becomes free to creep among the rocks at will, or swim gracefully with rhythmic beats of its long feather-like arms. Special interest attaches to this beautiful creature from the great part played by its relations, if not its ancestors, which lived during former periods of the earth's history, for the Encrinites, whose remains contributed to greatly build up the huge masses of our mountain limestones, were but gigantic Pentacrinoids of structure practically identical with the stalked larva of the *Antedon* (Hornell). Dr. Carpenter's "Microscope" has a good plate of the rosy feather-star. My remarks have been largely taken from "Gosse" and from Cassell's "Natural History," also from Hornell's "Journal of Marine Zoology."

Origin of English Scientific Societies.

From SCIENCE-GOSSIP.

At the opening meeting of the 147th Session of the Society of Arts, held on November 21st, 1900, the address given was by Sir John Evans, K. C. B., D. C. L., LL.D., Sc. D., F. R. S., upon the "Origin, Development, and Aims of our Scientific Societies."

Sir John Evans stated that no learned Society had received a Royal Charter before 1662, when the Royal Society was incorporated. The Society of Antiquaries was however, much older, having been founded about 1572. Among the meeting places of this staid and respectable body was the "Young Devil" tavern in Fleet Street. The Society before which the address was given was founded in 1754, and incorporated nearly a century later, in 1847, as the "Society for the Encouragement of Arts, Manufactures and Commerce." From the trio of Societies—the Royal, Antiquaries and Arts—Sir John mentioned that, nearly all the numerous leading learned societies in existence in this country had sprung by a natural process of evolution. The first, perhaps, was the Medical Society, founded in 1773. The Linnean Society for the cultivation of Natural History followed in 1788. The lecturer pointed out that during the century now drawing to its close the vast advances in science and the innumerable aspects which it assumed had led to the foundation of the numerous scientific societies with more or less limited scope. These were by no means confined to science as represented by the ordinary acceptance of the word, as many were literary and philosophical in their aims; that of Manchester dating back to 1781. The offshoots of the Society of Antiquaries had not been so numerous, nor so important, as those from the Royal Society; the field of archæological research being more restricted than that of pure "natural knowledge." The Society of Arts was the

first in England to devote attention to the important subjects of forestry and agriculture ; the Royal Agricultural Society not originating until 1838. It was the Society of Arts also that laid the foundation for the Institute of Civil Engineers and its offshoots. At the Society of Arts in 1841 there was formed the Chemical Society, from which arose the Institute of Chemistry in 1877. The same birth-place may be claimed for the Society of Chemical Industry and the Sanitary Institute. Similarly originated were the City Guilds Institute and even the Science and Art Department at South Kensington, though the latter was influenced by the Great Exhibition of 1851. The Photographic Society grew from an exhibition of photographs, the first of its kind, held in the Society's rooms.

It was also the parent of the Royal College of Music. Sir John Evans pointed to the fact that without our Societies it would have been impossible for knowledge to have progressed as it has during the past century. They bring about that healthy competition which stirs men from rest or torper ; a state once described by the secretary of the Society of Antiquaries, when he said ; "Would to God there was nothing in the world older than a new-laid egg."

Bacteriological Notes.

BY THE EDITOR.

IMPROVED CULTURE MEDIUM FOR GONOCOCCUS.—Tubes of gelose are melted, and cooled to 40° C.. Half the volume of blood—drawn directly from the artery of a rabbit—is added to the tubes of gelose, which are cooled in a slanting position. The growth of the gonococcus in this medium is very rapid, characteristic colonies being present in twenty-four hours.—*Annales Dermatologie*.

BACTERIA IN THE ARCTIC REGIONS.—Some interesting facts concerning the freedom of the air, water, and even the intestinal contents of animals of Arctic regions, from

bacteria are communicated by Dr. Levin, of Stockholm, (*Annales de l'Institut Pasteur*) who took part in the Natthorst expedition during the summer of 1898. Working each time with 20,000 liters of air, he found practically no bacteria. Sea-water, snow and ice yielded on an average one bacterium per 11 c.c. In twelve samples of brown mud he found only a single bacterium. The intestinal contents of polar bears, eider ducks and other birds, sharks, sea urchins, anemones, and crabs were nearly always sterile. Not only did he obtain no growths, but he was unable to find evidence of the presence of bacteria after staining the intestinal contents with the usual agents. The results confirm the conclusions of Nencki, Nuttall and Theirfelder concerning the presence of bacteria as a non-essential factor in digestion.—*American Journal of the Medical Sciences*.

A NEW BACILLUS FROM VACCINE LYMPH.—Nakanishi (*Centralbl. f. Bakt. Bd. xxvii, No. 18*) describes a bacillus which he finds constantly present in vaccinia pustules, and which he has experimentally investigated. This is present in the epithelial cells of the "vaccine pulp" of calves, either as a rod-shaped form, staining in a bipolar fashion, or as a spherical or oval form taking the stain less perfectly. In the lymph from children, on the other hand, the rod-form is not found, but large, round refractive organisms are present, similar to those found in calf lymph, which are looked upon by the writer as variation forms of the bacillus. Pure cultures of the bacillus were obtained on agar plates both from the calf lymph and from lymph drawn from seven-days-old vesicles on the arms of children. The organism grows but on solidified blood-serum, and resembles morphologically, the diphtheria and the so-called pseudo-diphtheria bacilli; it is a facultative anaerobe.

PNEUMOCOCCIC ARTHRITIS.—A case of pneumococcic ar-

thrititis with fatal termination has recently been reported. The illness began as an ordinary pneumonia and was later complicated by an arthritis of the left shoulder. After death, possibly within one hour, the skin over the deltoid muscle was seared with a hot iron and a sterilized needle was thrust into the joint. A syringeful of thick greenish, creamy pus was drawn off. This contained an abundance of pneumococci in pairs and short chains of three or four elements, distinctly encapsulated and in pure culture. The leucocytes were polynuclear. The cocci stained well by Gram's method, and when stained by Ziehl's solution and partly decolorized in one per cent acetic acid, the capsules were very well shown. Typical dew-drop cultures were obtained on agar and blood serum. Its virulence to mice or rabbits was not tested.

RAY FUNGUS.—R. J. Godlee, detailing a series of cases of Actinomycosis, in London *Lancet*, says: 'To the clinician the first sight of the fungus is usually obtained in the pus evacuated from an abscess, or in the expectoration, and it is visible to the naked eye as small, round granules, sometimes very minute, sometimes larger, oftenest of a pale yellow color, but sometimes white, which are easily demonstrated by allowing the pus, or expectoration to flow down the side of the test-tube while it is held up to the light, or to run over a microscopic slide.

They have been compared to particles of iodoform, but they are obviously rounded and not of such a bright yellow color. One should always be on the *qui vive* and get into the habit of looking at the pus from any abscess of doubtful origin from this point of view, but especially if, on opening the abscess, the amount of pus was less than was expected and the finger passes into an indefinite soft mass which bleeds with great freedom. The sensation imparted to the finger is very characteristic when one is accustomed to it. The hemorrhage suggests what is the fact, that the growth does not interfere with vessels and

is in itself very vascular. If a yellow granule be placed unstained in a little water on a slide and the cover-glass be gently pressed upon it, it will be seen under a low power to be made up of rounded masses which are yellowish on the circumference, but less colored in the centre. Under a high power the centre is seen to consist of a densely felted mass of threads which is called the mycelium, and the circumference to contain the so-called clubs which, from their radiated arrangement, have given the name to the fungus.

In some cases, however, these are not to be seen. It must not be supposed that the mycelium is made up of well-defined threads like the mycelium of a mould or a mushroom. It consists of extremely delicate branched threads in which a double outline is scarcely to be distinguished, and which sometimes appear to be made up only of chains of cocci, which has suggested the latest name for the organism, "*streptothrix actinomyces*." We are told that the organism is easily grown on various media and that it then consists at first of these threads, which after sometime end in chains of *streptothrix*, which are supposed to constitute the spores of the fungus. At all events these, if transferred to another medium, bud out into the threads of the so-called mycelium. The clubs are very seldom if ever produced in artificial cultures. In old cultures bulbous ends to the threads are sometimes observed, and it is held that the clubs are only produced when the organism is growing under difficulties.

Although it is practically certain that the organism grows on cereals and grass, very little is known of life-history as a vegetable parasite. It is, however, quite certain that it gains access to the bodies of men and beasts on pieces of corn or grass which either stick in the teeth, or mouth, or are swallowed or inhaled—the moral of which ought to be, that we should give up the tempting habit of chewing fresh corn, sucking straws or putting pieces

of fresh grass into our mouths. We cannot help inhaling the dust of a threshing-machine and are most likely exposed to the inroads of this pestilent organism in a thousand ways which it is impossible to guard against. Once settled in the mucous membrane of the mouth, oesophagus, alimentary tract, or respiratory passages, it begins to grow and creates inflammation. Sometimes an ulcer is produced, sometimes a sort of tumor, and it is usually the latter condition that the surgeon is called upon to treat or the pathologist to examine. The tumor is of a pale yellowish color, globular in shape, riddled with holes of a larger or smaller size containing pus, and very vascular, although it presents a superficial resemblance to the interior of a tuberculous or gummatous deposit. It infiltrates all the tissues with which it comes in contact, spreading in the intermuscular planes and to some extent into the muscles, extending far and wide into the calcareous structure of bones, occupying extensive portions of the solid viscera and forming communications between the hollow viscera.

It sometimes attacks the skin, sometimes it is met with in the lymphatic glands and occasionally it is distributed to distant parts of the body by the vascular system, exactly as in embolic pyemia ; it is then found in the brain or joints, or indeed any part of the body.

The younger forms are wedge or "candle-flame" shaped; others are rod-shaped, and in old cultures, club-shaped and rounded forms are common. Experimental inoculations in calves and guinea-pigs were negative. In rabbits, intra-peritoneal inoculations were also negative in result, but ulceration is produced by inoculation of the cornea, and in the epithelial cells of this, round or oval bodies are found. These are identical with the bodies described by Guinieri and Pfeiffer in the corneal tissue inoculated with vaccine lymph, and in the corneal vesicles in variola, and which were considered by them to be probably pro-

tozoa. By inoculation of cultures of the bacillus into the arms of several children, a student, and himself, the writer was successful in producing typical vesicles. Two other students gave no reaction; possibly they were immune. He argues that the described bacillus is in all probability the specific agent in vaccinia, but with regard to the round and oval forms found in the corneal epithelium, he hesitates to decide whether they are really varieties of the bacillus so modified by the unfavorable site on which they are growing or whether they are degeneration foci in the epithelial cells themselves. The fact that somewhat similar shapes are found in old cultures seem to give countenance to the first view. Much evidence has been collected to show that the protozoa of Guianieri, the so-called cytorrycytes variolæ, are characteristic and specific and as the writer has produced identical forms by inoculation of cultures of this bacillus, he deduces that the bacillus is characteristic of small-pox lymph, and in all probability is the exciting factor in small-pox itself. Further, as the organism resembles the diphtheria bacillus, he draws a parallel between this disease and variola clinically and pathologically, and finds close analogies.—*British Medical Journal*.

METHOD OF DISTINGUISHING COLONIES OF TYPHOID BACILLI FROM THE COLON BACILLUS.—Dr. J. A. Case (*Philadelphia Medical Journal*; *Indiana Lancet*) describes a specially prepared culture medium recommended by Piorkoski. This is made by taking 100 parts of urine that has undergone ammoniacal fermentation, to which is added 0.5 parts of peptone and 3.3 parts gelatin. The whole is heated over a water-bath for one hour, then filtered, placed in test-tubes and sterilized in the usual manner. The sterilization is repeated for ten minutes on the following day. To make the test, the stool of a patient is first rubbed up in a mortar, and three tubes taken, which

are inoculated as follows: The first tube by the contents of two platinum loops; the second tube is inoculated from the first, using four loops, and the third by six or eight loops from the second dilution. The contents of each tube is then poured into Petri dishes and placed in a cool place until the gelatin is solidified; it is then placed in an oven and kept at a temperature of 22° C. for twenty-four hours. At the end of this time the typhoid colonies are seen as transparent, filamentous bodies, along side of the coli colonies, which are rounded, with well defined edges. According to the writer, Piorkoski claims to have found the typhoid colonies as early as three days after the beginning of the illness, and he furthermore claims that they may be demonstrated in every case. Twenty-six cases have been tested, in all of which the results of the test were confirmed by the subsequent clinical history.—*Modern Medicine*.

A NEW PATHOGENIC MOULD.—W. H. Ophuls and H. C. Moffitt in the Philadelphia *Medical Journal* present a preliminary report of a new pathogenic mould which was formerly described as a protozoon under the name *coccidioides immitis pyogenes*.

The patient from whom the organism was obtained was a farm laborer aged nineteen, whose sickness began with a chill, eleven weeks before admission to the hospital.

After a few days the left pleura was tapped and a large quantity of clear fluid was removed. The patient had an irregular fever, the temperature at times reaching 104 ° F. The Diazo reaction was present, but not the Widal. About four weeks after the onset of his trouble, painful inflammation of the knees, elbows, wrists and ankles developed. Later, there was a fluctuating swelling over the left eye, and a large gland developed in the supra-clavicular fossa. There was cough, with muco-purulent and occasionally bloodstained sputum. There were no tubercle bacilli in the sputum. The lungs were irregu-

larly consolidated. There was bronchial breathing and harsh and dry rales. The heart was enlarged, but otherwise normal.

The leucocyte count was seventeen thousand. The patient died, ten days after admission, about twelve weeks after the onset of the disease. The autopsy showed acute bronchial pneumonia, abscesses of the retro-peritoneal lymph glands, and encapsulated empyema, enlarged and softened spleen, with colloid swelling of the liver and kidneys. In all the diseased parts that were examined there were found peculiar parasitic organisms, which in the few recorded cases, have been described as protozoa. The life history of these parasites shows the youngest forms as small, spherical masses of protoplasm enveloped in a membrane. The protoplasm is granular, stains well and is occasionally vacuolated. The organism sometimes attains a diameter of thirty micromillimeters and is always perfectly spherical.

When the adult stage is reached, the capsule breaks, and one hundred or more spore-like bodies are detached. Locomotion was never observed in the adult forms, nor in the spores. The close resemblance of these spores to coccidia, led to their classification as protozoa.

The lesions produced by their presence in the human body, are chronic suppurating processes. The organism grown upon agar-agar, showed mycelia. Inoculated into guinea pigs, it caused suppurating foci, and the same mould was recovered as had been noted in the patient. The organism was found to develop mycelia, when free in a culture medium such as a hanging drop of bouillon.
—*Medicine.*

Medical Convention.—The annual meeting of the Medical Society of the State of New York was held at Albany, Jan. 29, 30, 31, 1901. Full particulars from A. M. Phelps, M. D., 62 East 34th Street, N. Y. City.

MICROSCOPICAL SOCIETIES.

Quekett Microscopical Club.—The 380th ordinary meeting of this club was held on Friday, Oct. 19, at 20 Hanover-square. Mr. George Masee, F. L. S., president, in the chair. Messrs. Swift exhibited their new portable microscope as shown at a previous meeting, with the addition of their roller detachable mechanical stage and a sub-stage condenser for use with the lower powers, and of such a focus as to give dark-ground illumination through a fairly thick water trough.

Mr. D. J. Scourfield exhibited and described Mr. Ashe's camera-lucida, a form of Beale's well-known form, but which, by the introduction of a small mirror, obviates the drawback of the latter instrument, which inverts but does not transpose the image. Moreover, the drawing can be made at any angle of inclination of the microscope by the use of an inclinable table for the paper. Mr. Lewis communicated some interesting observations made by Mr. E. G. Wheler, on "A Remarkable Stigmatic Organ in the Nymph of *Ornithodorus Megnini*," and also on "*Ixodes tenuirostris*." Specimens and drawings were exhibited, Mr. D. J. Scourfield read a paper on "The Swimming Peculiarities of *Daphnia* and its Allies, with an account of a New Method of Examining Living Entomostraca, &c."

NEW PUBLICATIONS.

Laboratory Directions for Beginners in Bacteriology. Moore, Veranus A. Boston. Ginn & Co., 1900. The cordial reception tendered to the first edition of Dr. Moore's *Laboratory Directions for Beginners in Bacteriology* has caused the author to prepare a second edition. This edition is somewhat extended, and the literature thoroughly sifted. The course is certainly an excellent one and for a course of medium length has enough details to give the student a comprehensive idea of the subject. The work can be recommended most cheerfully to those pursuing a course in bacteriology.—L. H. PAMMEL.

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Recent Knowledge of the Bubonic Plague.

BY WILLIAM C. DOBSON, M. D.

This article includes also a review of the recently published *Text-Book upon the Pathogenic Bacteria, for Students of Medicine, and Physicians*, By Joseph McFarland, M. D., Professor of Pathology in the Medico-Chirurgical College, Philadelphia. Third Edition, Revised and Enlarged. 8vo. pp. 621. Illustrated with 142 Engravings and 3 plates. Philadelphia, W. B. Saunders & Co. 1900. Price \$3.25 net.

Part I of this work devotes a chapter to each of the following subjects, viz. Bacteria; Biology of Bacteria; Infection and Intoxication; Immunity and Susceptibility; Methods of Observing Bacteria; Sterilization and Disinfection; Cultivation of Bacteria; Cultures and their Study;

The Cultivation of Anaerobic Bacteria ; Experimentation upon Animals ; The Recognition of Bacteria ; Bacteriologic Examination of the Air ; Bacteriologic Examination of Water ; Bacteriologic Examination of Soil.

Part II Considers Specific Diseases and Their Bacteria. This division includes The Phlogistic Diseases, both acute and chronic ; The Toxemias ; The Bacteremias ; Miscellaneous diseases which are not included in the foregoing classifications. The Acute Inflammatory Diseases of Suppuration, Gonorrhoea, Mumps, Cerebro-spinal Meningitis and Pneumonia are ably handled and the chapters devoted to Tuberculosis, Leprosy, Glanders, Syphilis, Actinomycosis, Mycetoma, Farcin du Boeuf and Rhino-scleroma are of especial interest. The Toxemias of Tetanus, Hydrophobia, Diphtheria and Cholera, are brilliantly treated and lead to special articles upon Anthrax, Typhoid Fever, Yellow Fever, Chicken-cholera, Hog-cholera, Swine-Plague, Typhus Murium, Mouse-Septicemia, Relapsing Fever, Bubonic Plague, Tetragenus, Influenza, Measles and Malta Fever, which are calculated to show the education, research and experience of the author. The illustrations are admirably executed and the text excellent, two qualities, which when combined with scholarly classification, tend to produce a volume, of which the publisher may justly feel proud. We are pleased to quote at length from the article on *Bubonic Plague* ; which disease is caused by the *Bacillus Pestis Bubonicae*.

Plague, malignant poly-adenitis, is an acute febrile disease of an intensely fatal nature, characterized by inflammation of the lymphatic glands, marked cerebral and vascular disturbance, and the presence of the specific bacillus in the lymphatic glands and blood. The bubonic plague is an extremely fatal disease, whose ravages in the hospital in which Yersin made his observation, carried off 95 per cent of the cases. The death-rate varies in different epidemics from 50-90 per cent. In the epidemic at Hong

Kong in 1894 the death-rate was 93.4 per cent for Chinese; 77 per cent for Indians; 60 per cent for Japanese; 100 per cent for Eurasians, and 18.2 per cent for Europeans.

It affects both men and animals, and is characterized by sudden onset, high fever, prostration, delirium, and the occurrence of lymphatic swellings—buboes—affecting chiefly the inguinal glands, though not infrequently the axillary, and sometimes the cervical, glands. Death comes on in severe cases in forty-eight hours. If the case is of longer duration, the prognosis is said to be better. Autopsy in fatal cases reveals the characteristic enlargement of the lymphatic glands, whose contents are soft and sometimes purulent. Wyman in his very instructive pamphlet, "The Bubonic Plague," finds it convenient to divide plague into (a) bubonic or ganglionic; (b) septicemic; and (c) pneumonic forms. Of these the bubonic form is most frequent and the pneumonic form most fatal. The infection usually takes place through some peripheral lesion, but may occur by inhalation of the specific organisms. The bacillus of bubonic plague seems to have met an independent discovery at the hands of Yersin and Kitasato in the summer of 1894, during the activity of the plague then raging at Hong Kong. There seems to be but little doubt that the micro-organisms described by the two observers are identical. The bacillus is short and thick—a cocco-bacillus, as some call it—with round ends. Its size is small (2 mm. in length) and its form is subject to considerable variation. It not infrequently occurs in chains of four or six or even more, and is occasionally encapsulated. It shows active Brownian movement, which probably led Kitasato to consider it motile, while Yersin did not.

Gordon found that some, at least, of these plague bacilli have flagella. It is an ærobie organism. No spores are formed. It stains well by the usual method; not by Grams method. When stained the organism appears dark-

er at the ends than at the centre, so as to resemble a dumb-bell or diplococcus. The bacilli sometimes appear vacuolated and in old cultures show a variety of involution-forms. Kitasato has compared the bacillus to that of chicken cholera. In his studies of plague, Ogata states that while Kitasato found the bacillus which he had described, in the blood of cadavers, Yersin seldom found his bacillus in the blood, but always in the enlarged lymphatic glands. Kitasato's bacillus retains the color when stained by Gram's method ; Yersin's does not. Kitasato's bacillus is motile ; Yersin's, non-motile. The colonies of Kitasato's bacillus when grown upon agar are round, irregular, grayish-white with a bluish tint, and resemble glass-wool when slightly magnified ; Yersin's bacillus forms white, transparent colonies with iridescent edges. Ogata, in the investigation of the cases that came into his hands, found a bacillus that resembled that of Yersin, but not that of Kitasato, and it is certain that the description of Yersin is the more correct of the two.

In the *Japan Times*, 1899, Kitasato explains that his investigations being made upon cadavers that were partly putrefied, he was led to believe that the bacillus first invaded the blood. Later studies upon living subjects, showed him the error of this view and the correctness of Yersin's observation that the bacilli first multiply in the lymphatics. The studies of Kitasato and Yersin show that in blood drawn from the finger tips and in the softened contents of the glands, the bacillus may be demonstrable. When cultures are made from the blood or softened contents of the buboes, the bacillus may be obtained in pure culture, and is found to develop upon artificial culture-media. In bouillon, a diffuse cloudiness results from the growth, as observed by Kitasato, though in Yersin's observations the culture more nearly resembled erysipeles cocci, and contained zooglea attached to the sides and at the bottom of the tube of nearly clear

fluid. According to Haffkine, when an inoculated bouillon culture is allowed to stand perfectly at rest, on a solid shelf or table, a characteristic appearance develops. In from twenty-four to forty-eight hours, the liquid remaining limpid, flakes appear underneath the surface, forming little islands of growth, which in the next twenty-four to forty-eight hours grow down into a long stalactite-like jungle, the liquid always remaining clear. In four or six days the islands are still more compact and solidified. If the vessel be disturbed, the islands fall like snow and are deposited at the bottom, leaving the liquid above clear. Upon the gelatin plates at 22°C. the colonies may be observed in twenty-four hours by the naked eye. They are pure white or yellowish white, spherical in the deep gelatin, flat upon the surface, and are about the size of a pins' head. The gelatin is not liquefied.

The borders of the colonies are, upon microscopic study, found to be sharply defined and to become more granular as their age increases. The superficial colonies occasionally are surrounded by a fine, semi-transparent zone. In gelatin puncture-cultures the development is scant. The medium is not liquefied; the growth takes place in the form of a fine duct, little points being seen on the surface, and in the line of puncture. Sometimes fine filaments project into the gelatin from the central puncture. Upon agar-agar the bacilli grow freely but slowly, the colonies being whitish in color, with a bluish tint by reflected light, and first appearing to the naked eye when cultivated from the blood of an infected animal, after about thirty-six hours incubation 37 °C. Under the microscope they appear moist, with rounded, uneven edges.

The small colonies are said to resemble little tufts of glass-wool, the larger ones have large round centres. Microscopic examinations of the bacilli grown upon agar-agar, reveals the presence of long chains resembling streptococci.

Upon glycerin-agar the development of the colonies is slower, though in the end the colonies attain a larger size than those grown upon plain agar. Klein says that the colonies develop quite readily upon gelatin made from beef-bouillon (not infusion), appearing in twenty-four hours at 20° C. as small gray, irregularly rounded dots. Magnification shows the colonies to be serrated at the edges and made up of short, oval, sometimes double bacilli. Some colonies contrast markedly with their neighbors in that they are large, or looped threads of bacilli.

The appearance was much like that of the young colonies of the *Proteus vulgaris*. At first these were regarded as contaminations, but later he was led to believe that their occurrence was characteristic of the plague bacillus. The peculiarities of these colonies cannot be recognized after forty-eight hours. Involution-forms on partly desiccated agar-agar not containing glycerin, are said by Haffkine to be characteristic. The microbes swell up and form large, round, oval, pea- or spindle-shaped or biscuit-like bodies, which may attain twenty times the normal size, and in growing, gradually lose the ability to take up the stain. Such involution-forms are not seen in liquid culture. Hankin and Leumann recommend for the differential diagnosis of the plague bacillus, the addition of 2.5 to 3.5 per cent of salt to the agar-agar. When transplanted from the ordinary agar-agar to the salt agar-agar, the involution-forms which are so characteristic of the plague bacillus, form with exceptional rapidity. In bouillon with this high percentage of salt, the stalactite formation is very beautiful and characteristic. Upon blood-serum, the growth at the temperature of the incubator is luxuriant. It forms a moist layer of a yellowish-gray color, and is unaccompanied by liquefaction of the serum. Upon potato, no growth occurs at ordinary temperature.

When the potato is put for a few days in the incubator, a scanty, dry, whitish layer develops. Abel found the

best culture medium to be 2 per cent alkaline pepton solution with 1 or 2 per cent of gelatin, as recommended by Yersin and Wilson. The bacillus develops under conditions of aerobiosis and anærobiosis. In glucose-containing media it does not form gas. No indol is formed. Ordinarily the culture-medium is acidified by the development of an acid that persists for three weeks or more. By frequent passage through animals of the same species, the bacillus increases very much in virulence. Curiously enough, however, the observations of Knorr, substantiated by Yersin, Calmette, and Borrel, show that the bacillus made virulent by frequent passage through mice, is not increased in virulence for rabbits. Mice, rats, guinea-pigs, rabbits, monkeys, dogs and cats are all susceptible to inoculation. During epidemics, the purely herbivorous animals usually escape, though oxen have been known to die of the disease. When blood, lymphatic pulp, or pure cultures are inoculated into them, the animals become ill in from one to two days, according to their size and the virulence of the bacillus. Their eyes become watery, they begin to show disinclination to take food or to make any bodily effort, the temperature rises to $41.5^{\circ}\text{C}.$, they remain quietly in a corner of the cage, and die with convulsive symptoms in from two to seven days. If the inoculation was intravenous, there is no lymphatic enlargement, but if it was subcutaneous, the nearest lymph-nodes are always enlarged, and, in cases with delayed death, suppurated. The bacilli are found everywhere in the blood, but not in very large numbers.

Devell has found that frogs are susceptible to the disease. Wyssokowitz and Zabelotny found monkeys to be highly susceptible to plague, especially when inoculated subcutaneously. When so small an inoculation was made as a puncture with a pin, dipped in a culture of the bacillus, the puncture being made in the palm of the hand or sole of the foot, the monkeys died in from three to seven

days. In these cases, the local edema observed by Yersin, did not occur. They point out the interest attaching to infection through so insignificant a wound and without local lesions. According to Yersin, an infiltration of watery edema can be observed in a few hours, about the point of inoculation. The autopsy shows the infiltration to be made up of a yellowish gelatinous exudation. The spleen and liver are enlarged, the former often presenting an appearance, much like an eruption of miliary tubercles. Sometimes there is universal swelling of the lymphatic glands. Bacilli are found in the blood and in all the internal organs. Very often there are eruptions during life, and upon the inner abdominal walls there are petechiæ and occasional hemorrhages. The intestine is hyperæmic, the adrenals congested. There are often sero-sanguinolent effusions into the serous cavities.

Klein found the intra-peritoneal injection of the bacillus into guinea-pigs, of diagnostic value, producing in twenty-four to forty-eight hours a thick, cloudy peritoneal exudate, rich in leucocytes and containing characteristic chains of the plague bacillus. Animals fed upon cultures or upon the flesh of other animals dead of the disease, became ill and died with typical symptoms. When Klein inoculated animals with the dust of dwelling houses in which the disease had occurred, some died of tetanus, one from plague. Many rats and mice in which examinations showed the characteristic bacilli, died spontaneously in Hong-Kong. Yersin showed that flies also die of the disease. Macerating and crushing a fly in bouillon, he not only succeeded in obtaining the bacillus from the medium, but infected an animal with it. Nuttall in reviewing Yersin's fly experiment, found the statement true, and showed that flies fed with the cadavers of plague infected mice, died in a variable length of time. Large numbers of plague bacilli were found in their intestines. He also found that bed-bugs allowed to prey upon infected

animals, took up large numbers of the plague bacilli and retained them for a number of days. These bugs did not, however, infect healthy animals when allowed, subsequently, to feed upon them. Nuttall is not, however, satisfied that the number of his experiments upon this point was great enough to be conclusive. Ogata found that the plague bacillus existed in the bodies of fleas found upon diseased rats. One of these he crushed between sterile object-glasses and introduced into the subcutaneous tissues of a mouse, which died in three days with typical lesions of the plague, a control animal remaining well.

The guinea-pigs taken for experimental purposes into a plague district, and kept carefully isolated, died spontaneously of the disease, presumably because of insect infection. The animal most prone to spontaneous infection seems to be the rat, and there is much evidence in support of the view, that it aids in the spread of epidemics. At several of the Asiatic plague districts and at Santos the appearance of plague among the inhabitants was preceded by a large mortality among the rats, some of which when examined, showed buboes and had died of plague-septicemia. It is rather improbable that men become infected with plague through the bites of the fleas, leaving the bodies of plague-destroyed rats, as was once supposed. Galli-Valerio thinks the fleas of the mouse and rat are incapable of living upon man and do not bite him, and that it is only the *Pulex irritans*, or human flea, that is capable of transmitting the disease from man to man. Yersin found that when cultivated for any length of time upon culture media, especially agar-agar, the virulence was rapidly lost and the bacillus eventually died. On the other hand, when constantly inoculated from animal to animal, the virulence of the bacillus is much increased.

The bacillus probably attenuates readily. Kitasato says that it did not seem able to withstand dessication, longer than four days; but Rappaport (quoted by Wyman) found

that they remained alive when kept dry upon woolen threads at 20 °C. for twenty-three days and Yersin found that although it could be secured from the soil beneath an infected house, at a depth of 4-5 cm., the virulence of such bacilli was lost. Kitasato found that the bacilli was killed by two hours exposure to 0.5 per cent. carbolic acid, and also by exposure to a temperature of 80 °C. for five minutes. Ogata found that the bacillus was instantly killed by 5 per cent carbolic acid, and in fifteen minutes by 0.5 per cent carbolic acid. In 0.1 per cent sublimate solution it is killed in five minutes. According to Wyman, the bacillus is killed by exposure to 55° C. for ten minutes. The German Plague Commission found that the bacilli were killed by exposure to direct sunlight for three or four hours; and Bowhill found that they were killed by drying at ordinary room temperatures in about four days. It seems possible to make a diagnosis of the disease in doubtful cases by examining the blood, but it is admitted that a good deal of bacteriologic practice is necessary for the purpose. Abel finds that the blood may yield fallacious results because of the rather variable appearance of the bacilli, which are sometimes long, and easily mistaken for other bacteria. He deems the best tests to be the inoculation of broth cultures and subsequent inoculation into animals, which he advises should have been previously vaccinated against the streptococcus.

Plague bacilli persist in the urine a week after convalescence. Wilson, of the Hoagland Laboratory, found the thermal death-point of the organism was one or two degrees higher than that of the majority of pathogenic bacteria of the non-sporulating variety, and that, unlike cholera, the influence of sunlight and desiccation cannot be relied upon to limit its viability. Dr. Kitasato's experiments first showed that it is possible to bring about immunity to the disease, and Yersin, working in India, and Fitzpatrick in New York, have successfully immunized

large animals (horses, sheep, goats). The serum of these immunized animals contains an antitoxin capable not only of preventing the disease, but also of curing it in mice and guinea-pigs and probably in man. Haffkine in his experiments followed the line of preventive inoculation as employed against cholera. Bouillon cultures were used, in which floating drops of butter were employed to make the islands of plague bacilli float. The cultures were grown for a month or so, successive crops of the island-stalactite growth as it formed, having been precipitated by agitating the tube. In this manner there was obtained an "intense extra-cellular toxin" containing large numbers of the bacilli. The culture was killed by exposure to a temperature of 70 °C. for one hour, and the mixture used in doses of about 3 c.cm. as a preventive inoculation.

A most interesting collection of statistics, showing in a convincing manner the importance of the Haffkine prophylactic, is that of Leumann of Hubli. The figures, together with a great deal of interesting information upon the subject, can be found in the paper upon "A Visit to the Plague Districts in India" by Barker and Flint. The immunity conferred by the Haffkine prophylactic in doses of 1 c.cm. is of considerably longer duration, lasting about a month. The preparation must not be used if the persons have already been exposed to infection, and is possibly in the incubation stages of the disease, as it contains the toxins of the disease and greatly intensifies the existing condition. When injected into healthy persons it always produces fever, local swelling and malaise. Wyssokowitz and Zabolotny, whose studies have already been quoted, used 96 monkeys in the study of the value of the "plague-serums," and found that when the treatment has begun within two days from the time of inoculation, the animals can be saved, even though symptoms of the disease are marked. After the second day, the treatment cannot be relied upon. The dose necessary was 20 c. cm. of

a serum having a potency of 1 : 10. If too little serum was given, the course of the disease was slowed, the animal improved for a time and then suffered a relapse, and died in from thirteen to seventeen days. The serum also produced immunity, but of only ten to fourteen days duration.

An immunity lasting three weeks was conferred by inoculating a monkey with an agar-agar culture heated to 60 °C. If too large a dose of such a culture was given, however, the animal was enfeebled and remained susceptible. Of Yersin's serum, which is prepared by immunizing horses in the usual manner to toxins and cultures of the bacillus, 5 c. cm. doses have been found to confer an immunity lasting for about a fortnight. Larger doses confer a longer immunity. For the treatment of the developed disease, enormous doses of 50 and even 100 c. cm. seem to be necessary to produce the desired results, evidently indicating that the serums thus far obtained are weak.

BIOLOGICAL NOTES.

L. H. PAMMEL.

AUTO-INTOXICATION AND SPIROGYRA.—In a recent number of the American Journal of the Medical Sciences, Dr. Klingmann makes some interesting statements with reference to auto-intoxication and toxic states of blood. He has experimented with protozoæ and algæ, which were treated with various toxic substances. The alga used was *Spirogyra*. After describing briefly the normal peculiarities of *Spirogyra*, he shows that toxic substances like those produced in certain contagious diseases, and those following epilepsy, produced certain pathological changes in the *Spirogyra*.

“The water which is used for diluting the blood is tested by placing a few threads of *Spirogyra* in a glass dish

containing some of the water, and is allowed to stand for a few minutes ; if the water is non-toxic the specimen remains unchanged. The time in which the change will occur varies directly with the amount of toxin present and the species of *Spirogyra* used. In one case it was found that reaction took place after diluting the blood with five litres of water. In this way it can be determined whether the toxicity of the blood has increased or diminished. It was repeatedly observed that in testing the blood of patients who were convalescing, the time in which the reaction took place was greatly prolonged; in one case of diphtheria, this was noticed after two injections of antitoxin. In all cases examined, except those suffering from acute or chronic alcoholism and gout and rheumatism, a division of the protoplast of the *spirogyra* took place; in the cases of alcoholism, rheumatism and gout, the reaction was not the same as that occurring in the other cases, but resembled that described by Naegeli under the second heading; the chlorophyll bands were retracted from the protoplasmic cylinder and changed their general arrangement, and the nucleus changed its position and form." (*Am. Jour. Med. Sci.* 120 : 585.)

KARYOKINESIS.—In the October number of the *Popular Science Monthly* (57 : 664 : 1900) there is published the retiring address of Sir William Turner as President of the British Association. This paper considers the history of cytology, especially with reference to the multiplication of cells and karyokinesis. Those who are especially interested along this line will find this paper presenting the subject in a most admirable and concise form.

BUBONIC PLAGUE.—In the October number of *Popular Science Monthly*, (57 : 576. 1900), Dr. Frederick G. Novy discusses the Bubonic Plague. This paper deals chiefly with historical matters showing how the disease has spread to the various parts of the world at different times.

PLANT HYBRIDIZATION.—Mr. Herbert J. Webber who has charge of the plant breeding laboratory of the U. S. Department of Agriculture, has been making some interesting observations along the line of hybridization. Among the other plants studied he has done something with the pineapple ; he finds that some varieties are much more fertile than others. “In my own experience, the most fertile varieties are the Abbaka and Smooth Cayenne, two of the finest varieties known. Ninety-seven flowers of Abbaka crossed with pollen of Smooth Cayenne gave seventy-seven good seeds, and, in the case of the reciprocal cross, thirty-six flowers of the Smooth Cayenne crossed with pollen, Abbaka gave forty-six perfect seeds. Other sorts used in crossing, such as Golden Queen, Ripley, Red Spanish, Mauritius, &c., gave varying degrees of fertility between these two extremes.” (Separate Jour. Roy. Hort. Soc. 24.)

STUDY OF MANUFACTURED STARCHES.—In a recent bulletin of the Division of Chemistry, U. S. Department of Agriculture, Dr. Wiley discusses the manufacture of starch from potatoes and cassava and incidentally refers to the structure of microscopic characters of a number of other starches, and the amount of starch produced in the different plants. He also discusses the methods of manufacture. This paper is accompanied with several excellent plates. (Bull. Div. Chem. U. S. Dept. Agrl. 58.)

Actinocyclus Ralfsii.

EDWARD M. NELSON, F. R. M. S.

The interesting diatom, especially when viewed under a low power, is so transcendently beautiful that it will attract the attention of even those who, like Gallo, “care for none of these things.” The charm in this diatom consists not only in its remarkable system of rays, from which it derives its name, but also in its exquisite coloring.

When, however, this diatom is viewed in a critical manner with a wide-angled oil-immersion lens all its lovely color vanishes and its beautiful rays become so inconspicuous as to be hardly noticeable; in spite of this, however, its interest to a scientist will be rather increased than diminished. It is not difficult to account for the loss of the rays, for when the diatom is examined under a low power, the dots, or more accurately the minute perforations in the siliceous wall, are so closely approximated to one another that they appear to run together and form rays, but when this structure is examined under a higher power of greater aperture, these dots are so widely separated that they cease to give this appearance of lines or rays.

The reason for the loss of the color is not quite so obvious, for the color may be produced in a variety of ways e. g. by polarization, by the unequal refraction of light, by diffraction, by the varying thickness of transparent thin plates, and lastly by pigments. Now we know that exceedingly minute objects, such as bacteria and micrococci, when stained by pigments do not lose their color when examined by high powers; but on the other hand, objects such as diatoms, which owe their color to the diffraction of light by their minute structure, change their color from violet to red and finally lose it altogether as the power, or rather the aperture, of the objective is increased. It is an instructive experiment to examine with dark ground illumination and a low-power objective, say one inch or $\frac{3}{4}$ inch of aperture .25 to .3 N. A., a slide containing various species of *Pleurosigma* that have different degrees of fineness of structure; the coarser forms will appear ruddy, those a little finer, greenish, those still finer blue, and some finer still, will appear violet or indigo.

Now if the lens be changed for one whose aperture is .4 N. A., those that were ruddy will be colorless, and the structure that gave rise to the color will be resolved, those that were green will be ruddy, and those that were blue

will have become green, and so on. If a lens of still greater aperture be employed, those that were originally green will become colorless and will be resolved, and the colors of the others will be lowered a step in the gamut. This law, which holds good with other diatoms, quite breaks down with the *Actinocyclus Ralfsii*, for if we examine one on a dark ground with a low power those parts which were brilliantly colored blue with transmitted light now become a golden yellow. Again, all other diatoms lose their color when the structure which gives rise to it by diffraction is resolved, but with *A. Ralfsii* the color remains, although the structure is resolved, and lastly other diatoms when viewed by axial transmitted light appear white, while this is brilliantly colored, provided that a lens of suitable aperture be employed to examine it. The color in this diatom is visible with transmitted light, provided that the aperture of the objective used does not greatly exceed .45 N. A. ; the power of the objective or eyepiece is of no consequence, the aperture of the lens is the sole determining factor in the case, as may be proved by manipulating an iris diaphragm at the back of the objective.

There is a slide in my cabinet which contains both an *Actinocyclus Ralfsii* and a *Hyalodiscus stelliger*. This last diatom has an ordinary sieve-like structure of about 35,000 per inch. Now, these two diatoms act in precisely contrary manners, for on a light field with ordinary transmitted light the *Actinocyclus* is brilliantly colored while the *Hyalodiscus* is colorless; but on a dark ground the *Hyalodiscus* is colored, and the *Actinocyclus* colorless. In short, the *Hyalodiscus* follows the rule of all other diatoms, e. g., the *Pleurosigma*, *Naviculae*, etc., and behaves precisely like them. In *Actinocyclus Ralfsii* the only part which follows this general diatomic rule is the narrow margin which, with transmitted light, is a golden yellow. (This color may be somewhat erroneously described, as its

golden tint may be caused by the contrast with the brilliant blue close to it), but on a dark ground exhibits a blue-green tint; this is a diffraction color, which like all diffraction colors, turns white on resolution, or more strictly speaking shortly before resolution.

The tint of the diffraction color of a diatom depends upon the aperture of the objective used, and the obliquity of the illumination. By this means we may therefore roughly determine the fineness of any diatomic structure by matching the tint with one whose fineness of structure has been measured, or with a test plate or ruled bands.

Of course it is necessary that the comparison be made with the same objective and under the same conditions of illumination. A suitable illumination for this purpose is daylight, and an achromatic condenser with a central opaque stop, just large enough to give a dark ground.

The question then is: what is the cause of the color in *Actinocyclus Ralfsii*? Obviously it cannot be a diffraction color arising from the ordinary primary structure forming the "rays," which give the diatom its name, because as we have seen above, when this structure is resolved the color is still visible, and no color arising from diffraction is visible when the diffraction itself is resolved. It cannot be due to pigment, for if it were it would remain visible when the aperture was increased beyond .45 N.A. It cannot be caused by thin plates, because it would require reflected and not transmitted light to render it visible. Polarization and refraction seem quite out of the question; and as there is no other theory at hand, the answer must for the present be left undetermined.

It was pointed out in 1897 (Journ. Q. M. C., Vol. 6, ser. 2, p. 431) that with an apochromatic $\frac{1}{8}$ of 1.4 N.A., used in connection with a wide-angled oil-immersion condenser giving a large aplanatic cone, a very delicate perforated veil could be seen covering the whole valve of an *Actinocyclus Ralfsii*. This very delicate structure has ob-

vously nothing to do with the color in question, because it would require a far greater aperture than .45 N.A. to develop upon a dark ground, any color arising from the diffraction of so fine a grating ; and this question is quite independent of that concerning the different kind of illumination required to develop the color, a point of which we have as yet found no explanation. If a *Hyalodiscus subtilis* whose structure is about 70,000 per inch, or twice as fine as that of *Hyalodiscus stelliger*, be examined on a dark ground with a lens of .25 N.A. no color will be perceived, while the *H. stelliger* under similar conditions will be brightly colored ; if the aperture be increased to .5 or .6 the *H. stelliger* will be resolved, while the color of the *H. subtilis* will be an intense blue. Now the resolution of the *H. subtilis* may be accomplished with a dry lens of .95 N.A., used critically, but as this lens reveals nothing of the extremely delicate structure we are considering on *Actinocyclus*, it stands to reason that the color, observed in *Actinocyclus* with quite a low aperture and with transmitted light, cannot possibly be caused by this delicate structure. To repeat the argument :—

HYALODISCUS SUBTILIS.

This diatom when viewed upon a dark ground, with a lens whose aperture is .55 N.A., is colored ; the structure which gives rise to this color can be resolved by a dry lens of .95 N.A.

ACTINOCYCLUS RALFSII.

This diatom when viewed by transmitted light, with a lens whose aperture is .25 N.A., is colored ; the color remains when the coarse structure on the diatom is resolved ; a dry lens of .95 N.A., however critically used, is quite unable to resolve the fine veil on this diatom. If this fine veil were the diffractor which caused the coloration of this diatom, it would require a lens with an aperture of at least .55 N.A. to develop the color.

Finally, all diffraction colors vanish with transmitted

light, but the color of *A. Ralfsii*, with exception of that on its narrow margin, is only visible with transmitted light.

In this narrow margin the single process or nodule is situated ; this I find has a very finely perforated cap, very similar to those of the *Aulisci* which have been previously described. The resolution of this detail is exceedingly troublesome, and perhaps it is one of the most difficult images the microscope, as at present constituted, is capable of dealing with.—*The Quekett Club*.

The Limitations of Clinical and Microscopical Evidence.

W. K. JACQUES, M. D., CHICAGO.

To correctly interpret the phenomena of disease and health, one must have a clear conception of the relationship sustained by pathogenic bacteria in the causation of disease. The older bacteriologists, led by the great Robert Koch, believed and taught that germs were the cause of disease, using the word cause in its scientific sense. That is to say, that within the germ are all the elements which are manifest in the effect, disease. This was in direct opposition to the teachings of Virchow's cellular pathology. Between these great leaders and their followers, has waged a long war, with the gradual evolution of the fact that both are partly right.

Disease is a process brought about by many factors, no one of which may be the all sufficient cause, any more than the electric spark may be the all sufficient cause of a dynamite explosion.

The germ is many times the exciting cause, or the last factor added to set the disease process in motion. The Klebs-Löffler bacillus, the pneumococci and other microorganisms may be carried in the mouth of a healthy individual for long periods of time without becoming pathogenic, until the individual becomes susceptible through lowered vitality and the disease process is set in motion.

In these cases, predisposition is the last factor added. The germ is not the all sufficient cause, but is an important factor, capable of setting the disease process in motion and of influencing it when other factors are present. It is only when the relationship is recognized, that the limitations of the microscopic and clinical evidence in diagnosis can be understood. A germ disease is where the patient furnishes the conditions under which a germ can multiply and by its presence, or products, disturb the metabolism of the human cells. When the environment of the cells furnishes them with proper conditions, the resulting metabolism is a condition of health.

When there is introduced into this environment anything which depresses or stimulates the metabolism of the cells beyond normal limits, the resulting condition is called disease. Therefore it is important to understand those things which go to make up environment.

Temperature, food, the products of cell activity—such as the ductless glands—and poisons of various kinds, are factors of environment whose presence or absence may cause disease metabolism. The cell, therefore, is the dominant entity of life. From its environment it receives nourishment and the necessary stimulus which causes it to absorb, excrete and reproduce its kind. The bacterial cell does not differ in these essentials from the human cell. It is a living entity and its internal metabolism depends upon its environment. When the pathogenic germ finds in the human body, conditions which permit it to carry on its cycle of activity, its presence becomes a factor in the environment of the human cells, which causes disease metabolism. In the study of infectious diseases, it is important to recognize the individuality of the different pathogenic germs. Each is subject to governing laws, as definite as those concerning the human being.

Each germ by its form and structure and its former environment, possesses individual pathogenic power. All

micro-organisms are most susceptible to the environment.

Their life cycle is so short that they are able to adapt themselves to changing conditions much more readily than is possible in the animal cells. What is true of one germ, may or may not be true of another; each has its own range of temperature, food conditions and environment in which it becomes pathogenic or harmless. The effects of environment may be demonstrated by placing germs under different conditions and noting the results.

Most students are familiar with the results of growing the Loeffler bacilli on agar agar and other media. The bacilli of anthrax vary greatly under different conditions.

Prof. Adami has shown how the bacillus colli changes from the bacillus form to the coccus, as it passes through the tissues. Because of these morphological changes, it is difficult to identify germs by form alone. While they may resemble each other in form, they will differ in arrangement, staining qualities, virulence or other conditions. The tissues in which a germ is found growing, may assist in its identification. As knowledge of bacteria progresses, the necessity of not relying upon any one definite quality in identification, becomes imperative. Virulence is even more influenced by environment than form. If the germ metabolism takes place in the presence of free oxygen, the toxin may be oxidized and rendered harmless.

Cholin derived from nerve substance and neurin differ only in a molecule of water. One is but slightly poisonous and the other intensely so. When bacteria are able to break up the highly organized substances of the human body, these atoms at once enter into new combinations under the conditions which then exist. Scientists are realizing the necessity of studying pathogenic germs in the environment in which they produce disease. The student of malaria goes to the swamp, and the investigator of the plague, to Calcutta. In some of the more common germ diseases, it is often important that the microscopical ev-

idence must not be separated from the clinical. The bacteriologist may be able to identify a germ as soon as seen under the microscope, but to be absolutely certain, it is necessary to make cultures and animal tests. The methods are too cumbersome and take too much time for most diagnostic purposes. If the bacteriologist knows the clinical symptoms of the patient at the time the culture was taken, it might remove any uncertainty in the identification of the germ. For instance, a Health Department box was inoculated and sent to a pathological laboratory for examination.

The bacteriologist reported the finding of the diphtheria bacilli. Had the culture been accompanied with the information that it had been inoculated from a healthy vagina, the germ would have been recognized as the bacillus vaginalis. The method of taking the culture is also important. The condition of material sent to the laboratories often shows very careless methods or ignorance of bacteriology. The surface of the medium is scarcely touched with the inoculating swab; cotton swabs come wrapped in newspaper, envelopes, or dirty bottles. Some of the fluids of the body are destructive to germs. When taking blood for examination, it should be at once diluted by large quantities of broth to prevent it from destroying the germs. It is the verdict of the bacteriologist that swabs from suspected anginas should be used at once to inoculate culture media. If this is not done at once, the action of the saliva may destroy the bacilli and thus prevent the detection of their presence.

For this reason, swabs alone cannot be sent by mail. It must be remembered that culture media furnishes a different environment than the human tissues and modifications in the morphology and virulence of germs may occur. Most students of bacteriology know the variations which occur in the Loeffler bacillus when grown on agar agar and blood serum; but it is not so well known that

serum from bovines, causes a short thick bacillus and that from sheep and dogs, a longer one. The tubercular bacillus has been identified by its staining qualities until now almost without question. The recent work of bacteriologists show that other bacilli not only have the same form but the same staining reaction as the tubercular bacillus.

A smear from the prepuce of a dog and one from tuberculous sputa, both prepared and stained by carbolfuchsin method will give a similar field. In the diagnosis of pulmonary tuberculosis in its early stages, the limitations of the microscopic examination, if not understood, may result in serious consequences to the patient. At this stage the tubercular foci may not be in a condition to throw the bacilli into the sputum. They may be in such limited numbers, that they can only be found with difficulty.

If a physician depends upon the negative answer of the bacteriologist, he may let the time pass when it is within the power of any help to stay the tubercular process.

The tuberculin reaction in careful hands is of value, but has not yet reached the stage of application needed for use by the general practitioner. It is generally understood that the term diphtheria is applied to that disease which is caused by the multiplication of the Loeffler bacillus in a susceptible individual. The necessity for giving antitoxin early, forces the physician to make a diagnosis as soon as possible. The rapid multiplication of the bacilli at the point of invasion, the peculiar arrangement, the morphology, which is fairly maintained by the bacilli when growing in culture, in a large per cent of cases make the identification of the germ reliable. It has been a great relief for the physician to unload his cares on the shoulders of the bacteriologist. It seems too bad that the latter is getting tired and insists in returning the responsibility to the family physician, where the patient has placed it. All a bacteriologist can say when ex-

aming cultures, is that he finds a germ corresponding to the Klebs-Löffler bacillus. It is for the physician to complete the diagnosis by putting with it the clinical symptoms and to decide whether or not the disease process is in motion.

There is such a wide range in the morphology of the diphtheria bacillus that it is not easy to identify. There are other germs which resemble it so closely that it is sometimes difficult to distinguish them. The Löffler bacillus may have all grades of virulence. The long variety is the most virulent, yet the short form may be toxic and the non-virulent form cause death by strangulation. The site of the invasion may not be where the germs can be obtained, or antiseptic gargles may have been used.

The culture medium may be contaminated. To properly appreciate the value of microscopical evidence, a physician should be familiar with those conditions which promote accuracy and success. While it would be little short of criminal to discard the use of the microscope in the diagnosis of diphtheria, it should be kept in mind that there are conditions where this evidence may be absent and the patients life be dependent upon the recognition of the clinical symptoms. The diagnosis of scarlet fever is always important and sometimes difficult.

The rash may be slight and the clinical symptoms not clear. If the physician has made a thorough study of the class coccus in relation to this disease, he will find it of value in making a diagnosis and in protecting susceptible individuals. In this case it is environment which causes malignancy. Scarlet fever is produced only by the multiplication of the infection in the blood of a susceptible individual.

This environment cannot be produced in the laboratory. If bacteriologists will take their microscopes to the scarlet fever patient and study the germ under the conditions in which it causes disease, they will find evidence that it

is the causative germ. When I have found this germ in large numbers in cultures from anginas, I have put the attending physician on his guard and the rash has been observed when it might otherwise have been overlooked. In one case of an adult, the rash was so slight that there was some question about it, but a considerable amount of albumen appeared in the urine ten days after. A congested throat may cause a soil in which the coccus may multiply and produce a severe angina.

If the blood is not susceptible, it remains a local inflammation ; if it is, scarlet fever follows. In the diagnosis of gonorrhoea, the microscope is of importance in the acute stage.

It will also show the value of different methods of treatment. Its greatest importance is in the examination of individuals who have had this disease at some remote period and who wish to know, before intended marriage, if the gonococcus is still present. In such cases the clinical symptoms may be entirely absent, but germs may remain for long periods of time in the interstices of the prostate gland, or other parts of the genital tract, in sufficient numbers to infect a female under the conditions of marital relations. By the careful examination of the discharges from these parts, the gonococcus may be found and the unhappy consequences to the future wife averted.

Microscopic evidence is far too often neglected in the diagnosis of influenza. There are saprophytic bacteria living in the human mouth which take on virulence under favorable conditions and produce severe catarrhal disturbances. These germs stand in a similar relation to influenza that the germs causing anginas do to diphtheria. If a correct diagnosis could always be made, the germ would soon assume its proper position as a disease causing factor. Influenza is contagious and should be isolated. Invalids and people of advanced years are susceptible, and it is the duty of the physician to protect them

as he would children from scarlet fever. In the diagnosis of malaria, the assistance of the microscope should not be ignored, but in order to appreciate its value, the life cycle of the plasmodium, its various forms and all the conditions under which it may be found, as well as the various forms of the disease in which it is absent, must be understood. The physician should keep pace with the work of the bacteriologist in order to properly value microscopic evidence.

When the Widal test for enteric fever came out, we were amazed at the accuracy with which it confirmed the diagnosis of typhoid fever. Extended knowledge has demonstrated that it is not infallible. Allowing that in a small per cent of cases the reaction is not present, it is by far the most reliable evidence we have in typhoid diagnosis at the present time. It is to be hoped that further investigation will determine when the reaction is not reliable.

There is a tendency among those physicians who have not had a bacteriological training, to under-estimate the value of microscopical diagnosis.

Influenced by the teaching that the germ is the all sufficient cause of disease, the bacteriologists in the past have claimed too much. To them the germ was the disease. Now that the bacteriologists have had to recede from this position, the doctor who does not use the microscope, believes that it weakens all microscopical evidence. This is not true. Microscopical evidence is of more value than ever before, if the physician has the knowledge to appreciate it. The fact that we have a pseudo-typhoid, a pseudo-diphtheria and possibly a pseudo-tubercular bacillus which causes the bacteriologists to hesitate, only emphasizes the necessity of the physician being a closer student of the problem of environment; of the germ which causes virulence, and environment of the patient which causes susceptibility. In a germ disease, there is a battle between

two living entities, or rather two armies of living cells. When pathogenic germs find a human organism weak enough to permit an invasion, the battle is on, each using utmost power to overcome the other. If the human cells are slow to act and the germs, or their products, are able to overcome some vital center, death results. If they respond quickly, antitoxins, phagocytes and digestive products are poured into the blood, the invading germs are overcome, digested and excreted. The existence of the human organism and its ability to complete its life cycle, depends upon its power to maintain germ immunity. The microscope, with careful technique, at times gives results with almost mathematical accuracy, which cannot be claimed for the uncertainties of clinical diagnosis alone.

In the use of the microscope, a physician should keep in mind that most often the greatest safety of his patient, and his own best mental development, comes through the close study of the clinical phenomena of disease. *Clinic.*

MICROSCOPICAL MANIPULATION.

PROPER ANGLE OF THE MICROTOME KNIFE.—Dr. B. Rawitz (Journ. Micros.) finds from experiment that the microtome knife should be placed at an acute rather than at a right angle. When placed at the latter angle, the sections, according to their thickness, are always more or less crowded together, thus distorting the finer structures of the tissues cut.

PATCHES ON SYCAMORE LEAVES.—If one will examine the under side of a sycamore leaf, he will probably find a number of minute dark brown discs attached to it. These, if carefully transferred to a microscope slide and moistened with a drop of water, or perhaps better, a 50 per cent solution of liq. potassæ, will show with a $\frac{1}{2}$ in. or $\frac{1}{4}$ in. objective, very pretty objects. They belong to the group of

fungi Ascomycetes, popularly known as "Sac fungi," and these particular ones are probably *Uncinulæ mecatior*, or an ally, others similar are found on Virginia creeper and lilac leaves. If the cover-glass be pressed a little, asci with ascospores may be forced out. Some suppose the black spots on the leaf are due to a fungus; this may be so. I have carefully examined these spots for years, and have never been able to connect the one with the other, and shall be glad to hear more about this interesting microscopical subject.—W.H.D.M.

MICROCHEMICAL DEMONSTRATION OF THE PRESENCE OF COPPER.—For the demonstration of the presence of copper by microchemical means, according to Pozzi-Escot in the *Chemische Zeitung*, two compounds of copper iodide and ammonia are especially suited. An ammoniacal copper oxy-salt solution, decomposed by the addition of potassium iodide, yields a crop of minute blue tetrahedric crystals, with the formula $\text{CuI}_2, \text{NH}_3, \text{H}_2\text{O}$. If to an ammoniacal copper oxy-salt solution, sufficient ammonia be added to dissolve the copper salt by aid of heat, and the same be heated about 40°C ., under the addition of sodium or ammonium iodide, the liquid becomes yellowish green, and brown-black rhombic tablets, whose composition has not yet been established, are thrown down. The substance is probably $\text{CuI}_4, \text{NH}_3$. It is very easily decomposed—disappearing fully within 10 minutes, leaving only yellowish green prismatic tablets to be seen.

NEW PUBLICATIONS.

The Microscopy of Drinking Water.—By George Chandler Whipple. New York, John Wiley & Sons. 1899. pp. 292, Plates xix.

In this work, the historical matters are given, besides a very excellent account of the object of the microscopical examination of water, and the different methods in vogue such

as Sedgwick-Rafter, the Plankton net method, the Plankton pump, the Plankton krit, each of these given in sufficient detail to enable any student to make use of them. In chapter IV the writer considers the microscopic organisms in water from different sources such as rain water, ground water, surface water. The bacteria are largely omitted. There is a brief allusion to them as well as one plate describing the different types. Then the writer takes up the subject of Limnology treating the ponds and lakes, their geology, geography, physics, chemistry, biology and the relation of these to each other. The work is an excellent one and should be in the hands of one who are interested in the study of water and its organisms.—L. H. PAMMEL.

Text Book of Inorganic Chemistry, By Victor von Richter, edited by Prof. H. Klinger of the University of Königsberg, and translated by Edgar F. Smith, Professor of Chemistry in the University of Pennsylvania, Philadelphia. Fifth American from the Tenth German Edition, containing 68 illustrations on wood and a colored lithographic plate of 'Spectra. 8 vo. pp. 430. Philadelphia, P. Blackiston's Son & Co., 1900. Price \$1.75 net.

In presenting this subject to the student, the author has made it a point to bring out prominently the relations existing between fact and theory, which treatment will greatly aid the student in obtaining a thorough knowledge of a highly important science. Ample space has been given to the consideration of the more recent, well-established discoveries in chemical science and valuable additions have been made relating to the general properties and measurement of gases, to the atmosphere and the interesting constituents lately observed in it, to the theory of dilute solutions and electrolytic dissociation, to the electrolysis of salts, to alloys, etc. This work, which reflects credit upon both author and editor, we are pleased to endorse and recommend to the profession and scientific public.

DIE MIKROSKOPISCHE ANALYSE DER DROGENPULVER.—
Microscopical Analysis of Powdered Drugs—An atlas for Apothecaries, Druggists and Students of Pharmacy, by Dr. Ludwig Koch, professor of botany at the University of Heidelberg. First volume, First number. Published by the Brothers Borntraeger, Berlin, 1900. Price 3 marks 50 pfennig (85 cts.), post free.

The contents of this first volume embrace the Cortices and Ligna (barks, peelings and woods) of the German Pharmacopœia, the present issue being devoted to *Cortex Aurantii Fructus*, *Cortex Cascarillæ*, and *Cortex Chinæ Succirubræ*—these being preceded by a general and special introduction, in which the methods of investigation, including preparation of the sample, the media, reagents, etc., are fully set forth, as well as the special microscopical methods of research. There is also a special introductory dissertation on the Cortices of the Pharmacopœia, their anatomical structure, etc.

The work will appear in parts, from time to time, but without fixed periods of issue, until completion, each part costing 3 marks and 50 pfennigs, or say 85 cents of our money. The exact number of issues has not yet been announced. Every apothecary interested in the microscope, and every student of pharmaceutical microscopy should have this work. Nothing like it has ever been issued in any language, and that it is in German, should make but little difference, in this region, at least, where a general knowledge of German is almost universal among the educated classes. The plates alone are worth the money asked for the book.

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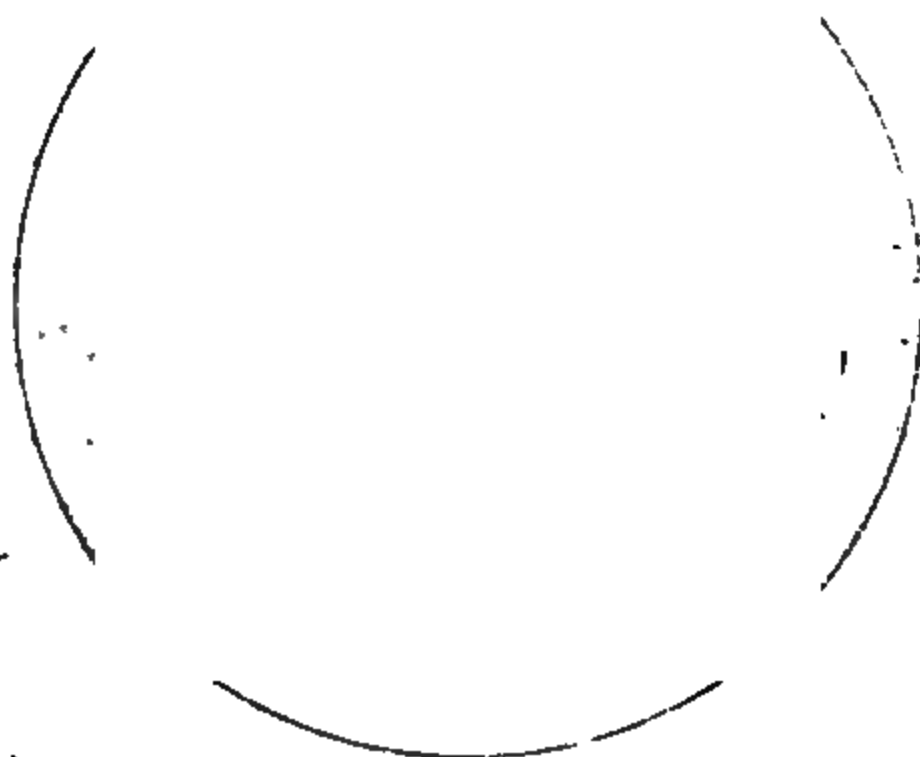
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2.—TAPEWORM PARASITE.

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Technique For the Recognition of Certain Animal Parasites In Man.

L. NAPOLEON BOSTON, M. D.

ANCHYLOSTOMA DUODENALE.—The condition produced by this parasite, when present in the intestinal canal of man, is known as brickmakers' disease, or tropical anæmia. Ova of this parasite are found in the feces of infected persons, and their detection is readily accomplished in the following manner: To a small portion of a recently voided stool, sufficient water is added to produce a cloudy liquid, when the stool and water are thoroughly mixed. A portion of the mixture is placed into a test tube and either centrifugated, or allowed to stand for a

few hours. A portion of the sediment thus collected at the bottom of the tube is lifted by means of a pipette, and a drop of it placed on the center of a slide, when it is covered by a second slide or a coverglass. The specimen is now ready for examination and should be studied under a $\frac{2}{3}$ lens, where the ova appear as small, round, opalescent bodies. Individual ova may be studied under a higher power lens—1-5 to 1-8 (Fig. 1—1 Natural size ; 2 head ; 3 tail ; 4 ova). These ova are well preserved when mounted in cast medium or in glycerine.

After the administration of certain drugs, the adult worm appears in the feces as a silky, slightly curved thread whose color is not constant. The parasite's detection is facilitated by adding water to the feces and stirring to effect a perfect mixture which is then set on either a light or dark surface. A thin spread of diluted feces is in this way produced, and affords a favorable field upon which to find the parasite. Adult worms are preserved in 70 per cent alcohol. My specimens were first placed in alcohol, and later in glycerine for 24 hours, from which they were mounted in cast medium. Glycerine jelly is also a valuable mounting medium for animal parasites. The anchylostoma is known to be the cause of a large percent of deaths in tropical districts, and is of especial interest since Surgeon B. K. Ashford, U. S. A., has shown it to be most common in Porto Rico, and other West Indies isles.

TAPE WORMS.—Segments of these parasites are commonly passed with the stool, and their study and general characteristics differ in no way from where the parasite is expelled as a result of therapeutic measures. The freshly voided segments are first washed in water and then placed in 70 per cent alcohol for twenty-four hours, when they are transferred to xylol for twenty-four hours and then mounted as follows : A portion of a segment is placed on a slide, and teased to shreds. After a short exposure to the air (five minutes) a drop of Canada balsam is added

and on it a coverglass placed. Prepared in this manner the ova are readily seen through a $\frac{3}{4}$ lens, and when viewed under a $\frac{1}{2}$ lens, both their outline and structure are apparent. Staining is accomplished by Delafield's hæmatoxylin and other dyes, but adds little, if anything, to the specimen's value. Study of the segment in its entirety is most interesting, but scarcely necessary in clinical work. It may be accomplished by placing a segment between two slides and clamping them tightly together. Under a $\frac{3}{4}$ lens the segment may be studied, showing the uterus stuffed with ova.

TO DETECT THE HEAD.—This being the portion of the parasite's study wherein most failures are experienced, and to which most importance is attached, I shall consider under the following heads: (1) Empty the bowels, by means of salines, so that no undigested food remains in the alimentary tract; (2) the administration of a vermicide; (3) follow in four to six hours by another saline; (4) when it is observed that the worm is beginning to escape from the rectum, the patient is directed to occupy a comfortable seat where the worm can pass into a clean vessel containing water; (5) it is all important that the patient sit on one commode from the time he observes that the worm is diminishing in size, until the entire worm is passed; (the nearer the head, the smaller the segments), when within a few inches, 10 to 12, of the head the worm appears as a pale slightly flattened thread and its segments are not distinct; (6) the head is the last portion of the worm to be passed, and as long as any part of the parasite is protruding from the rectum the probabilities are that the head has not yet escaped.

Given a specimen collected in this manner, add to it a quantity of water, stir gently with a glass rod, after which it will be seen that the worm falls to the bottom of the vessel, when decant one-half, or more, of the liquid, which is replaced by clean water. This washing is repeated un-

til the worm is cleansed. The worm, with the water surrounding it, is now transferred to a clear glass dish 10 x 12 x 3 inches, which is placed on a white surface (towel) and all large segments are removed by a glass rod, drawing them over the edge of the dish, when they are allowed to fall into a second dish containing water; care being taken not to break the parasite.

After all large segments are removed, the head is usually readily detected, by the naked eye, floating amongst the remaining thread-like portions of the parasite. In searching for certain small parasites a hand-glass may be found for service. The head is transferred to 50 per cent glycerine and preserved for further study. In mounting parasite heads, a slide provided with a concavity of sufficient depth to accommodate their thickest portion, is most satisfactory. They are well preserved when mounted in Farrant's medium, cast medium, glycerine and glycerine jelly (Fig. 2—1 Natural size; 2 head; 3 ova).

TÆNIA ECHINOCOCCUS (DOG TAPE WORM).—Here the problem is somewhat different, as man is the intermediary host, and in him develops the head, or scolex of the parasite only. Each head is provided with a crown of hooklets, and many free hooks are often seen in connection with shreds of finely granular, yellowish membrane (Fig. 3). Hooklets, scolices and membrane from the cysts of the echinococcus are occasionally found in sputum, pus from abscesses, the fluid of cysts, feces and urine. Hooklets are best studied under a $\frac{1}{2}$ lens, while the heads may be detected under a much lower power. It is these findings which enable one to recognize the parasite, and the hooks may be the only evidence present. In the study of this parasite a low power of illumination is necessary, and the skillful manipulation of both Abbe condenser and iris diaphragm afford great assistance. Products of the echinococcus may be mounted in any of the above mounting mediums.

TRICHINA SPIRALIS.—The larvæ of this parasite appear in the muscular tissue of man after the ingestion of uncooked, infected pork. They make their appearance early in the diaphragm, frontal, and muscles of the leg. The material to be studied is collected by the physician in the following manner: The site of incision is over the outer head of the gastrocnemius muscle, and after this area is surgically cleansed the parts are anæsthetized by injecting a solution of cocaine hydrochlorate. First inject the skin and then deeper structures down to the sheath of the muscle. When anæsthesia is produced an incision is made dividing all tissues to the muscle's sheath, which is grasped by a rat-tooth forceps and incised, after which a small

FIG. 3.—*T. echinococcus*. Scolex and hooklets (B. L., 1-6)

FIG. 4.—*Trichina spiralis* in muscle from outer head, left gastrocnemius. Twenty-first day of disease (Queen, $\frac{2}{3}$).

portion of the muscle is dissected and placed in a vessel containing water. Glycerine and alcohol arrest all movements of the parasite. This wound is now closed and dressed antiseptically. A small piece of this tissue is placed on a slide and teased, by means of fine needles, until most of its fibres appear to be separated. The addition of a few drops of water to the specimen renders the teasing process less difficult. The slide is now viewed under a low power ($\frac{1}{2}$), and if trichinæ are present their rec-

ognition is easy (Figs. 4 and 5); however, a very low illumination is required. After a few weeks the trichina become encapsulated by the patient's tissues, when they appear as small solid bodies showing a parasite tightly coiled in their centre. Trichina are also well preserved by any mounting medium containing glycerine.

DISTOMA HÆMATOBIA (BILHARZ).—The adult parasite is probably located in the veins of the bladder, and there deposits its ova which find their way into the bladder or bowel, and appear in the urine or stools. Bilharz's parasite is a common cause of bloody urine in certain geographical districts. To detect the ova allow the urine to stand until all blood clots are collected at the bottom of the

FIG. 5.—*Trichina spiralis*. Eighth week of disease.

FIG. 6.—Bilharz's parasite. (1) Ova (B. L., $\frac{2}{3}$); (2) ova (B. L., 1-6).

tube; (2) lift a portion of this sediment into a pipette and place a drop on the centre of a slide; (3) tease the clots as fine as possible, and evaporate nearly to dryness; (4) add a drop of cast medium, or glycerine, to the centre of the specimen upon which place a cover-glass and spread the medium by additional pressure. The specimen should be placed on a flat surface for twenty-four hours while the mounting medium hardens, after which time a permanent ring may be added. For rapid diagnosis the specimen may be mounted in water. Detection of these ova is best

accomplished by the $\frac{3}{4}$ lens (Fig. 6). Individual ova may be studied under a higher power, when it is often possible to distinguish the contained embryo which varies in its appearance with the age of the egg. Influenced by temperature, these embryos are freed from their shell in from a few hours to several days after they are passed with the urine. The most immature ova are about 1-400 inch in length and 1-600 inch in breadth, while fully matured ova measure 1-280 inch in length and 1-226 inch in breadth. The study of ova in feces needs no special explanation.—*Am. Jour. Phar.*

History of the Compound Microscope in Pharmacy.

Compound microscopes with objectives and oculars fairly well corrected for spherical and chromatic aberration have been in use for nearly seventy-five years, but it is only recently that they have been extensively employed in pharmaceutical practice. This is due to the fact that pharmacy as a science is of recent origin; only within the last decade have the courses of instruction in the colleges of pharmacy been based upon scientific principles—at least this applies to the department of botany and its various branches, as vegetable materia medica, vegetable pharmacography, and powdered vegetable drugs. The leaders in pharmaceutical education admit that a good compound microscope is a part of the necessary equipment of the intelligent, competent practicing pharmacist. It is therefore much to be regretted that there are a number of so-called colleges of pharmacy from which students are graduated who have never used or even seen a compound microscope. Such graduates are wholly unfit for the duties of a modern pharmacist, because it is only through the intelligent use of this instrument that he is enabled to vouch for the purity of most of the vegetable drugs and many other substances used in his practice.

The advance workers in pharmaceutical vegetable histology abroad, as well as in this country, have employed the microscope for a number of years. A few eminent specialists of Germany and France have studied the histology of medicinal plants since 1825. The earlier German investigators also devoted much of their attention to the microscopical examination of foods and spices, textile fabrics, and various other commercial products. Some of this work was really Herculean, and it would be highly interesting to enter into a fuller discussion, but space will not permit. Those who have the time and opportunity can look upon the results of such work as recorded in German pharmaceutical and botanical journals and in the various reports on hygiene and city sanitation.

According to Pocklington, the use of the compound microscope in English pharmacy dates from 1850, when Dr. Hassell laid before the Botanical Society of London a paper on the histology of coffee and its adulterants. The microscope was introduced into American pharmacy a few years later. In England, as well as in the United States, the use of the compound microscope in pharmaceutical practice progressed very slowly, until about 1880 or a few years later, in spite of the earnest recommendations of a few leading teachers and investigators. Since 1880 some very energetic work has been done in America. Many of the investigations are, however, defective, and a mere repetition of the work already done in Continental Europe, particularly in Germany. It is much to be regretted that a truly scientific spirit does not more permeate English-speaking nations. The great majority of the scientific work done is primarily instigated and abetted by commercialism and hence does not attain to the lasting, far-reaching results of the work of our patient and careful German investigators, whose prime motive is to find out.

In 1853, Dr. F. Hoffmann recommended the use of the

compound microscope in American pharmacy, calling attention to the value of this instrument in the examination of vegetable drugs and their adulterants. It was, however, not until some thirty years later that the compound microscope was used to any considerable extent in the study of vegetable drugs. It was looked upon as an impracticable instrument, having no commercial significance, and presenting no advantages over the simple microscope. Now and then some teacher or investigator would arise and reiterate the recommendations of Dr. Hoffman, or present some new phase of microscopic work in pharmacy, only to be met with the same indifference, if not actual opposition and ridicule. It is, therefore, little wonder that slow progress should have been made in the histologic study of medicinal plants.

In Germany the compound microscope found a steady use in pharmaceutical practice. In 1865 Berg published his excellent atlas illustrating the histology of the more important vegetable drugs, and even at this date there is nothing produced by an English or American investigator which equals this work.—ALBERT SCHNEIDER, M. D., in *Meyer Bros. Druggist*.

A Peep Through the Magic Glass.

S. P. SAUNDERS.

From paper on Sponges, read before the O. C. P.

I desire to give you a peep through this magic glass, but before doing so I shall try to describe the scene.

Before you lies a wide stretch of lively water of the most varied and brilliant shades of blue, green, purple, slate, brown and yellow. This remarkable diversity of colors is altogether caused by the nature of the bottom, as the water itself is absolutely clear and colorless. In the distance is a broad expanse of burnished and moving emerald. This indicates a bottom of white sand. Across the emerald run serpentine bands of celestial blue where

the hurrying tide has cut a channel away. Away to the right is a marvelous picture of purple and slate grey intertwinning and intermingling. The transformation is caused by a coarse sea-weed which thickly covers the bottom. On every side are patches of vandyke brown. Beware of them, as they reveal the whereabouts of the dangerous coral shoals. In front is a broad sheet of yellow brown, which indicates a rocky bar. You are going to this bar, as it is the home of the sponge zoophytes and numberless other forms of marine animals. The fresh trade-wind is blowing, and has stirred up a short, lively sea: the mimic waves are dancing and leaping and tossing their foam-covered crests.

Although the water is transparent, yet its rapid and continuous movement prevents your seeing the objects on the bottom clearly. You may make out their form, but the objects appear also to be in motion, and it is impossible to recognize them. Fortunately the disturbance is only on the surface.

Now you take up your magic glass, place it on the water and immerse its glass-covered end a few inches, and look. What a wondrous revelation. A wide radius of bottom clearly shown, and the objects lying or growing on it are distinctly seen and magnified. This combined effect of water and glass forms a lens of great magnifying power. Many of you have observed a similar magnifying effect on fish when swimming in a glass globe filled with water.

The water glass magnifies with so much power that a five cent piece lying on the bottom twenty feet down can easily be seen.

Through the magic glass a new and beautiful world is revealed to your enraptured gaze. The rocky bottom is everywhere covered with lovely forms of marine life. Gorgeous Gorgonias, yellow and purple, fan-shaped or long-plumed and fernlike, waving and swaying with every



pulse of the flowing tide. Corals, cone-shaped and erect, lofty carved columns, others like the branching antlers of the stag, others again broad and massive like those of the moose. Exquisite finger corals, embroidered and carved in the most skillful and delicate manner by the little marine architects. Round solid pieces like the human brain, the fully opened rose and dahlia. Pieces with spreading wings like a butterfly, and others that look like beautiful stalactites.

As the boat moves slowly onward you come to veritable coral grottos. All about them and in their limpid depths thousands of brilliantly uniformed fish are manœuvring. Sea anemones garland the sides of the shoal, and a chevaux de frise of sponges, sea urchins, black, white and yellow, covers the top and ambuscades the approaches.

As you gaze enraptured into these moss-lined coral caves, it requires no great stretch of the imagination to conceive them to be the enchanted retreats of the fabled siren and mermaid. As you proceed, troops of great yellow and brown star-fish appear, and huge conchs, bearded with green and russet sea-weed.

Occasionally a small body, with staring eyes and eight long tentacles, is seen prowling slowly around—'tis the repulsive and dreaded octopus. Or perhaps a great broad, black monster, with wing-like fins and long whip-like tails comes boldly swimming along—the ray, or devil-fish.

All about are red and black sponges, many of them two feet in diameter. Some of curious form and structure, others plume-like and feathery, and over all the bottom are patches of green and red and brown algæ, the ferns and flowers of the sea.—*Can. Phar. Jour.*

HE HAS 21 VOLUMES.—I enclose check for subscription. I have been a subscriber from the start and do not wish to let it lapse.—Jos. Jackson. We appreciate this kind of subscriptions.

The Germ of Cancer a Protozoan, a Single Cell.

DR. HARVEY R. GAYLORD, BUFFALO, N. Y.

We succeeded in cultivating, with comparative regularity, directly from cancer, from fluids which were in contact with cancer and from experimental animals these organisms, the protozoa. We are prepared to state that all the organs, including the blood, taken from all regions in all cases dying of cancer, including sarcoma and epithelioma, contain large numbers of organisms. We have likewise observed in all cases of carcinoma and sarcoma thus far examined that the organisms, especially the younger forms, can be detected in the peripheral blood.

The quarter-grown forms of the organism of cancer conform very closely in appearance with the amœboid bodies found in the blood by Pfeiffer and Reed after vaccination and in cases of small-pox. The question of the appearance of these organisms and the utilization of this fact as a means of diagnosis already forms the subject of a piece of research in our laboratory.

Fourteen guinea pigs inoculated in the peritoneum with peritoneal fluid containing the organism gave an average length of life of 58 days; 4 inoculated in the peritoneum with cancer mush gave an average length of life of 57 days; 11 inoculated in the peritoneum with dried cancerous lymph nodes, gave average length of life of 45 4-11 days; 6 guinea pigs inoculated with peritoneal fluid and lymph nodes from animals which were infected in the above manner, gave an average length of life of 29 days—a little more than half the length of time for the animal inoculated directly from man.

This unquestionably shows the increased virulence of the organisms after passing through an animal. We are continuing these experiments in modified form and shall report on them later.

The average length of life for rabbits inoculated in va-

rious regions with the different forms of material used shows the greater resistance of this animal to infection. In our most recent experiments we have succeeded by growing the organism in a collodion sac in the peritoneal cavity of a rabbit, in so increasing the virulence of the organism that a healthy rabbit inoculated in the ear-vein died of general hæmatogenous infection from the organism after a period of 15 days.

It will be seen from these experiments that animals are readily infected when inoculated with carcinomatous material as well as pure cultures of the organism. The peritoneal fluid used in all of these inoculations was bacteriologically sterile and consisted essentially of a pure culture of the organism. A guinea pig and a rabbit which were inoculated with filtered serum from which the organism had been removed, gave a respective length of life of 304 days and 164 days. The organs of these animals were free from parasites.

The microscopical pathological findings in these cases were generally uniform. All the animals were greatly emaciated and presented, on opening the abdominal cavity, collapsed intestines, reddened peritoneum, enlarged peritoneal lymph nodes and a moderate amount of clear straw-colored fluid. The lungs were dark red in color, collapsed, heart containing but a small amount of blood, spleen enlarged and reddened, liver in many cases hyperæmic, and the kidneys generally injected.

In almost all cases, a fresh examination was made of the peritoneal fluid, the organs, and the blood; and whenever made, large numbers of the parasites could be readily detected, as already described.—*American Journal of Medical Sciences*.

LATE.—Owing to a sudden and unexpected removal of our office, our work was disturbed and thrown behind in a troublesome manner but we are now catching up.

Notes on Microscopy.

F. SHILLINGTON SCALES, F.R.M.S.

ROYAL MICROSCOPICAL SOCIETY.—On November 21st, Mr. Wm. Carruthers, F.R.S., President, in the Chair. Mr. Nelson exhibited and described an erect-image dissecting microscope by Leitz, sent for exhibition by Mr. Baker. The erection of the microscope image, effected by means of Porro prisms, was first described by Behrens in the Journal of the Society in 1888. This instrument was valuable as a dissecting microscope; it was provided with hand-rests and three objectives having a very long working distance. Mr. Disney exhibited a diffraction plate, having the lines ruled in concentric circles, by which the diffraction bands were separated with great clearness. The rulings were about 7,000 to the inch. He also exhibited a steel brooch, the surface of which had been ruled in the same way. The method by which the lines were produced was at present a secret. The articles were of English manufacture, and had been lent to him by Messrs. Townson and Mercer. Mr. C. F. Rousselet exhibited an electric lamp for use with the microscope. After six months' trial he had found it very satisfactory for work with low and medium powers. It was manufactured by Edison Swan Co., and was called the "Focus" lamp. The President called attention to the exhibition that evening of a number of slides from the Society's cabinet, prepared by the late Dr. Carpenter in connection with his investigations into the shells of the mollusca. Mr. B. B. Woodward, who has given much attention to this subject, had also brought down some valuable preparations for exhibition. Mr. Vezey, at the request of the President, read a short abstract, copied from the Report of the British Association for 1846, which was a *resume* of the original communication on shell structure made to that Association by the late Dr. Carpenter, to illustrate which the

slides exhibited were prepared. The President then called upon Professor Charles Stewart, who, having referred to the views held upon shell structure at the present day, and taking the common pinna shell as an example, proceeded by the aid of drawings on the blackboard to demonstrate how its structure was built. Besides studying the sections usually made, he recommended that the shells should be broken and the fractured surfaces examined, if a correct idea of the formation of the shells was to be obtained.

FRESHWATER ENTOMOSTRACA.—Mr. D. J. Scourfield, in the Proceedings of the South London Entomological and Natural History Society, calls attention to the value of Entomostraca in experimental biology. "Their commonness in all parts of the country, their transparency, the ease with which they can be isolated and reared under all sorts of conditions, mark out the Entomostraca as particularly well fitted for observation in connection with even the most fundamental biological problems of the day." He adds: "We badly want detailed studies on local faunas, on the seasonal distribution and variation of different species, on the faunas of various types of ponds, on the food of the most abundant forms, and many similar subjects."

J. SWIFT & SON'S CONDENSERS.—Messrs. J. Swift & Son have submitted for inspection two excellent condensers of their manufacture. The first is apo-chromatic, and has a numerical aperture of .95. Its aplanatic exceeds, however, according to our measurements, .90; and as the value of a condenser for anything approaching critical work depends on the aplanatic cone of light that it transmits, it will be seen that this condenser is eminently fitted for such work. As an apo-chromatic system it is, of course, distinctly freer from color than even the best achromatic system can be made, and this is very manifest when using high-angled lenses. The power is about one-third of

an inch, and the price, without mount, \$20. We can recommend this condenser for all high-power work, and it is of interest to remember that, so far as we are aware, Messrs. Swift & Son share with Messrs. Powell & Lealand the distinction of being the only makers of apo-chromatic condensers throughout the world. The second condenser is achromatic, and is an oil-immersion with a numerical aperture of 1.4 and an aplanatic cone that we estimate as exceeding 1.3. The corrections of this condenser are also excellent, and the working distance is ample, even with a thick slide. The power is about $\frac{1}{4}$ -inch, or $\frac{3}{4}$ -inch with the front lens removed, and the price without mount is \$19. Both condensers are constructed with the newer makes of glass manufactured in Jena. It says much for the enterprise, and the keen competition perhaps, of our English opticians that we should have been able to notice in these columns within a short period three different immersion condensers of high excellency by three leading makers.

TARIFF EFFECTS.—American prices would scarcely serve for the English market, an apo-chromatic 1-12-inch oil-immersion objective of N.A. 1.3, for instance, being priced at \$120 = £24, and the corresponding objective of N.A. 1.4 costing \$160 = £32. Zeiss' price for similar lenses are respectively £15 and £20. The stands are built entirely upon the Continental model, which is closely adhered to, not only in the horse-shoe stand and in the fine adjustment, but also in the later Continental forms of sub-stage arrangements.

THE ORDINARY COLLODION.—Flexile collodion is used medically and contains castor oil. We would recommend, however, Schering's Colloidin, which is largely used by microscopists for section cutting. It can be obtained in chips or solution. A bottle containing 50 grams of the latter can be obtained from C. Baker for 30 cents. Beech-tar creosote is to be preferred, especially for cleaning col-

loidin sections, but coal-tar creosote would do equally as well, provided it is equally white.

Extracts From Postal Microscopical Society's Note-Books.

BACTERIA IN WATER.—A few weeks ago I noticed that a glass ornament on the sideboard in my dining-room contained some flowers in rather cloudy water, and guessing that carelessness had led to the water being left too long I examined a drop of it for infusoria under a moderately high power. I was surprised to find that the water was absolutely thick with every kind of schizomycetes, micrococci, bacteria, bacilli, spirillæ, vibriones, and leptothrix forms, besides a few paramœcia, monads, etc. The spirilla forms were unusually plentiful and active, and several zoogloean masses of bacteria were noticable. I mounted some slides from the liquid, of which the accompanying is one. The microbes are stained with logwood on the cover-glass and mounted in balsam. They will afford a test for the excellence of the objectives, condensers, and fine adjustments of our members' instruments. The vibriones have taken the stain best, the other forms indifferently. By the way, though balsam-mounting is always recommended in the text-books, bacteria show much better mounted dry on the cover-glass. At least I find it so. A good quarter-inch objective, which will bear a high amplification, shows well-stained objects perfectly well.

EXAMINING BACTERIA.—If a slide is prepared for photo-micrography, gentian violet is the most suitable stain. Take a drop of the bacterial solution on a platinum wire, and touch with it a clean cover-glass that has been washed with water and alcohol. Then take a second glass, rub the two together so as to get a nice clear film on the glasses. Then filter some fuchsine in aniline, and place the cover-glasses in the pigment. Occasionally take out one with the forceps, and if stained wash well in alcohol.

Now stain again in the methyl blue, wash in dilute sulphuric or nitric acid, then again in alcohol, and when the cover-glasses are dried with a piece of filter-paper or blotting-paper they can be mounted in balsam. It seems a tedious process, but when understood is very easy. I often examine spleen for tubercle bacilli by this method in fifteen minutes. A splendid double stain can be purchased from Messrs. R. & J. Beck, of Cornhill, London, for one shilling per bottle, which saves great work, but the solution must be warmed before use.—*J. Swift Walker, M. D.* Logwood is not a good stain for bacteria. Some of the aniline stains, such as methyl blue or gentian violet, give much better definition. A preliminary fixation by heat or absolute alcohol is also desirable. Mr. McGhie would then have no hesitation in mounting them in Canada balsam, as the staining would be very pronounced.

SCALES OF CLOTHES-MOTH.—This slide may be considered a trivial one to send around; but though the scales are not rare, they exhibit much beauty of marking in the way of striæ and villi when examined under moderately high powers, besides making a charming dark-ground slide under $\frac{3}{4}$ inch or 1-inch objectives. I have included the slide, however, principally because I think these scales exhibit better than any others the evolution of the insect scale from the simple hair, or rather the probable lines on which it took place. The piece of wing on the same slide shows well the distribution of the scales; flatest on the centre of the membrane, and shading off into bundles on the edges. In the nervures a crooked system of vessels is perceptible, and these may be traced right through to pedicles of the tufts of bristles at the wing's point, the function being, I believe, to supply the scales with the liquid which, according to Dr. Royston Pigott, is found between the upper and lower membranes of the scales. I am writing without the book, but think this is so. There is certainly, as can be clearly seen with a good objective of wide

angle, an intricate system of capillaries feeding every pedicle in the membrane.

ANTENNÆ OF COCKCHAFFER.—Of all points shown by antennæ, I think there are not any more peculiar and interesting than those of the organs of the cockchafer, with their leaf-like expansions, folding out upon one another like the sticks of a fan. This slide contains two of these lamellæ mounted in balsam. Carpenter (7th edition, 1891, p. 912) says of these markings: "A curious set of organs has recently been discovered in the antennæ of many insects, which have been supposed to constitute collectively an apparatus for hearing. Each consists of a cavity hollowed out in the horny integument, sometimes nearly spherical, at others flask-shaped, and again prolonged into numerous extensions formed by the folding of its lining membrane; the mouth of the cavity seems to be normally closed by a continuation of this membrane, though its presence cannot always be satisfactorily determined; whilst to its deepest part a nerve-like fibre may be traced." The cavities may be viewed from above under a magnification of 1,000 diameters, and also the aspect they present when seen partly sideways at the edges of the lamellæ. A memoir of the structure by Dr. Hicks is to be found in the "Transactions of the Linnæan Society," xxii. page 147.

PADDLE-LEG OF DYTISCUS MARGINALIS.—This needs little notice. *Dytiscus marginalis* is one of the best-known of the beetle tribe. A friend of mine, who has a large conservatory containing an artificial pond—the waters of which, by the way, have developed a remarkably rich growth of diatomaceæ—found a fine large specimen of the larval form of this formidable insect that was working great havoc among the tadpoles of the aquarium. He kept it alive in a glass jar for several weeks, and we were able to watch its habits. Its fierceness and voracity correspond with its repellent aspect. This is, of course, the

hind leg, which is specially adapted for swimming by the flattening of the tibiæ and tarsi, and by their being furnished with rows of long bristles. The fore-legs of the males are even more interesting, the basal joints being expanded into broad flat plates, furnished with curious sucker-like discs, which secrete an adhesive fluid similar to that in the foot of the housefly.

EPIDERMIS OF LEAF OF AURICULA.—This was stripped from the underside of a leaf, treated with dilute nitric acid, and stained and mounted in Canada balsam. Its main interest lies in the glandular hairs, which are best seen with a $\frac{1}{8}$ -inch objective, and in the stomata.—M. T. MCGHIE.

I have been much interested in some of Mr. McGhie's slides, and always like to see members prepare their own slides.—ED

TUBERCLE IN SPLEEN.—A high power objective is necessary to properly display the stained *Bacillus tuberculosis*. I have examined the section with a 1-12-in. oil-im. and fail to detect any bacilli. The abbreviations at corner of label of slide—which I construe to mean: par. = paraffin, as embedding agent; al. car. — alum carmine, as stain; or. — oil of origanum, as clearing agent; C.B. = Canada balsam, as mounting medium—represent a method of preparation not calculated to demonstrate tubercle bacilli. The nuclei of the tissue are well stained, and the tubercle, which in the spleen is always secondary to tubercle elsewhere, is seen as miliary granulations, but no bacilli are visible. The bacilli are not readily stained in tissue such as this. The Ziehl-Neelsen method is the best. The special advantage of this method is that not only does it demonstrate the tubercle bacilli, but it is at the same time diagnostic, as no other bacilli are stained in this way except the bacilli of leprosy. The method is as follows: the sections are transferred from weak spirit to carbolic

fuchsin stain for fifteen minutes, then decolorized in weak sulphuric acid (sulphuric acid, 10 c.c.; distilled water, 30 c.c.), and afterward rinsed in 60 per cent alcohol and washed in a large quantity of water to remove the acid. The sections may then be counterstained with methyl blue then dehydrated in absolute alcohol, cleared in cedar oil, and mounted in Canada balsam. The bacilli will then be stained red and the surrounding tissue blue.—*J. R. L. Dixon.*

EDITORIAL.

GOULD'S ILLUSTRATED DICTIONARY OF MEDICINE.—As a *vade mecum* of everything pertaining to the microscope, either for the amateur or professional worker, Gould will be found most satisfying. Under the definition "Microscope" is an illustration with each part named, and each term applying to the science is properly defined. Under the heading "Stains" is an elaborate article giving all Fluids used for fixing and hardening, Media for examination and preservation, etc., and methods employed in biologic investigation. This was written by an expert, and submitted to a practical microscopist before printing. The formula and uses of each fluid or preparation is carefully stated and its synonym mentioned, together with the authority recommending its use, if such use be doubtful.

PERSONAL.—The Popular Science Monthly for May opens with an article by Dr. W. J. Holland, Director of the Carnegie Museum at Pittsburg, describing the institution which Mr. Carnegie has so liberally endowed, and which it is said he intends to make the greatest institution of its character in the world. The article is fully illustrated, and includes plans for the enlargement made possible by Mr. Carnegie's recent gift of \$3,000,000. Dr. Holland has long been one of our subscribers.

EXHIBITS.—The Photography and Microscopy section

of the Franklin Institute, Philadelphia, proposes to hold the photographic exhibition early in 1902, and lasting about three weeks. Photo-micrography and Microphotography are included. Further particulars from F. M. Sawyer, Secretary of the Committee.

PARASITES OF MAN.—Through the kindness of Professor Henry Kraemer of the Philadelphia College of Pharmacy, who loans the cuts we are able to present the paper of Dr. L. Napoleon Boston, the Bacteriologist to the Philadelphia Hospital and Demonstrator in the Medico-Chirurgical College, which paper was read in the Philadelphia College of Pharmacy, April 16, 1901. In connection therewith, he exhibited slides of these parasites of different stages of development. Those who discussed the paper commended its practical importance. Professor Kraemer secured the paper for publication in the American Journal of Pharmacy and made the photo-engravings from the slides.

MICROSCOPICAL MANIPULATION.

DETECTING HUMAN BLOOD.—A new and seemingly important plan has been brought out by M. S. Cotton in Bull. Soc. Chimique de Paris. Blood will liberate oxygen from hydrogen peroxide. Using 1 c.c. of blood with 250c.c. of hy. per., he obtained for man, 580 to 610 c.c. O., for horse and pig, from 320 to 350 c.c.; for ox, 165 to 170; for guinea pig, 115 to 125; and, for sheep, from 60 to 65 c.c. This large excess in man over all the lower species would seem to be of diagnostic value.

Microscopical Examination of Substances in Small Quantities.—Professor Kraemer has found by experiment, difficulties in the work which prevented uniform crystallizing of the same substances. With solutions of alum in watch crystals, the crystals separate in 3 or 4 different forms apparently of the same system, though possibly of

different ones. Calcium oxalate occurs in monoclinic and tetragonal systems. Microscopic physical conditions must be taken into account in work of this kind.

A NEW METHOD OF COUNTING THE WHITE CORPUSCLES has been devised by Kourloff (*Vratch*). It is a dry method, and consists in drawing the blood into a graduated pipette, depositing a thin film on two cover-glasses, whose surface is measured by a network of lines. The white cells are then counted and the area measured by means of the movable stage and Ehrlich's diaphragm. This method allows the operator to work without haste and the results can be verified at any time. The writer asserts that he can count from 1,000 to 2,000 more white cells than by the Thoma-Zeiss cell, the dilutant in that method changing and destroying some white cells.

STAIN FOR ELASTIC FIBERS IN SPUTUM.—L. Michælis (*Deut. Med. Woch.*, April 4, 1901) gives the results of mixing various basic stains with resorcin, all being equally effective in staining elastic fibers in sputum. He prefers fuchsin, resorcin, and ferric chloride, which produces a dark blue stain. The suspicious part of the sputum is spread between two cover-glasses and allowed to dry in the air. A cover-glass is then immersed in a glass containing the stain, which can be used a long time. The alcohol in the staining solution acts as a fixing agent, and in half an hour the specimen is removed, rinsed in water, and placed in a three-per-cent hydrochloric acid solution until it appears colorless. It is then dried and covered with a drop of cedar oil. Examine with a microscope, and the elastic fibers will be stained a dark violet, while all other fibers, such as wool, cotton, and vegetable fibres from food, are not stained. This method gives us another means of making an early diagnosis in tuberculosis, as there is no element in the sputum of bronchitis which gives this reaction.—*Med. Age*.

QUICK METHODS OF STAINING THE GONOCOCCUS.—In the *Zeitschrift fur Wissenschaftliche Mikroskopie*, Unna gives the following quick method of staining gonococcus for diagnostic purposes and immediate examination. On a glass slip, let fall a drop of from a half to a 1 per cent alcoholic solution of anilin red, spread and dry quickly. A drop-let of the suspected matter is then put on the slip, on the spot where the red was applied, a cover-glass put on, and the slip transferred to the stage of the microscope and examined. The gonococci, if present, commence instantly to take up the coloring matter, and may thus be easily discovered.

LIMPID SOLUTION OF COPAL FOR MICROSCOPICAL USE.—The writer hereof has long used the following method of preparing gum copal for microscopical purposes. It furnishes an absolutely colorless and limpid preparation: Dissolve 1 part of camphor in 12 parts of sulphuric ether, add 3 parts of pulverized gum copal to the solution. Cork the flask tightly and set aside, with an occasional agitation until the copal is partly dissolved and partly swollen to its fullest extent. Now add $\frac{1}{2}$ part of rectified oil of turpentine and 4 parts of alcohol 96 per cent, and agitate briskly. Set aside for a week or so, giving the flask daily occasional lively shakings. At length the copal will be found entirely dissolved, and the contents of the flask separated into two layers, one of which, the lower, is dark, thick and possibly full of sedimentary matter, while the upper is limpid, clear as a crystal and rich in copal. Siphon off or decant the latter for use, and if too thin the solvent may easily be driven off. While the residual matter in the flask still contains considerable copal, which may be extracted by repeating the operation, it will be found more economical to operate with a fresh charge of copal, when more is wanted.—*Nat. Drug.*

STAIN FOR URINARY DEPOSITS.—For staining the mor-

phological elements found in urine, the best stain that we have yet found—and we have been experimenting in this direction for a quarter of a century—is boro-eosin. It is prepared by dissolving one gr. of borax in 19 ccm. of distilled water on the one side, and on the other, 50 cgm. of eosin in a mixture of 10 ccm. of alcohol and 40 ccm. distilled water, and mixing the solutions. Filter and keep in a glass stoppered bottle.—*Nat. Drug.*

BIOLOGICAL NOTES.

CLASSIFICATION OF POLLENS.—The subject has been to me of great interest, and after 45 years of constant though intermittent examination, it may be interesting to some to compare a few notes. Now the shapes of pollen are doubtless the first striking facts, and I have been struck by the identity of shape of all the Compositæ—viz., globular and spiked like the horse-chestnut hull. But the forms are very numerous. There are many four-keeled or four-lobed ellipsoids, the breadths being from $\frac{1}{2}$ to $\frac{1}{3}$ of the lengths. Then, of course, the sizes vary immensely; the evening primrose and the poinsetta are 1-160in. in length, though totally different in shape. The azalea is the smallest I have. It is spheroidal, and only 1-2200in. Mould spires I measure to be 1-8000in., and so there is endless variety of size, shape, color, and sometimes surface markings—to wit, the geranium and the passion flower. I am curious to know whether anybody has hitherto noticed the similarity of the shapes of the pollen of all the Compositæ. I may mention that I always use a $\frac{1}{4}$ in. objective and an eyepiece giving me 18-1000in. as diameter of field always lighted by a parabolic reflector from below, getting the pollen on a common slide. Habit has given me great rapidity of examination, and the colors and markings come out beautifully. I have had hours of great enjoyment from this alone.—*W.J.S. in Eng Mech.*

SMALL-POX.—The State of Michigan is pretty well “peppered” with the disease, it now being present in one hundred and two places, and it has existed, since January 1, in one hundred and eighty-two places.

During the ten years from 1890 to '99 there occurred in Michigan 710 cases of small-pox of which 134 died; a fatality of about 19 per cent. During the single year 1900, there occurred 608 cases of small-pox of which 8 died, a fatality of a little over 1 per cent. At the close of the first quarter of 1901, final reports have been received of seventy-seven outbreaks, showing that 500 cases occurred, including 7 deaths, a fatality of a little less than one and a half per cent.

BACTERIOLOGY.

A CONSTANT MICRO-ORGANISM IN SCARLET FEVER.—Baginsky and Sommerfeld (*Berl. klin. Woch.*, 1900, No. 28 u. 29; *Monat. fur. Prak. Dermat.*, Mch., 1901) state that in all cases of scarlatinous sore-throat, a prevailing streptococcus, sometimes in pure culture, more usually together with other cocci, is present. In all their investigations of scarlet fever in children a streptococcus was found in all the organs, also in the blood and bone-marrow. These micro-organisms appear as a round coccus with a single round nucleus, forming a short or long chain. It grows in alkaline bouillon, agar, blood-serum, etc. It does not liquefy gelatine. It stains slightly with all anilin stains. Specific characteristics have not yet been ascertained.

TUBERCLE BACILLI IN BUTTER AND MARGARIN.—Markl (*Wiener Klin. Woch.*, No. 10, 1901) states that during the past five years many investigators have found virulent tubercle bacilli in market butter. The question is, what percentage of market butter contains bacilli, and what is the danger of eating butter? Investigators differ wide-

ly in different localities, so the author made experiments with the market butter of Vienna. He used the Obermueller method, ejecting the centrifugated melted butter into the abdominal cavity of animals. In all, he inoculated forty-five guinea-pigs, and not one died of true tuberculosis or showed signs of the disease; one case proved to be pseudo-tuberculosis. Ten animals died of peritonitis, but none injected with margarin died from peritonitis. In the case of pseudo-tuberculosis he found a long acid bacillus taking Gram's stain, and which he considers the cause of pseudo-tuberculosis as well as Petri's and Hormann-Morgenroth's bacilli.—*Med. Age.*

THE CHEMISTRY OF CANADA BALSAM.—Tschirsch (*Archiv der Pharm*) publishes the results of his researches on this balsam. He finds the acid in a number of samples he has examined to lie between 82.2 and 86.1. The saponification number varied from 194.2 to 197.7. Among the resin acids present he finds canadinic acid, $C_{19}H_{34}O_2$, and canadolic acid, $C_{19}H_{32}O_2$. Two isomeric amorphous acids, a- and b- canadinolic acids, were also found to be present in considerable quantity. Canaderesene, $C_{12}H_{40}O$, was also isolated. By the distillation of the balsam with steam a small quantity of an essential oil, boiling between 160° and 167° C., was obtained.

MICROSCOPICAL SOCIETIES.

SATURDAY NIGHT CLUB OF MICROSCOPISTS.—A reception of the Club was held at Franklin Institute Hall, Philadelphia, on Saturday, December 15, 1900. There were present, besides the regular Club members, a large number of invited guests. The speaker of the evening was introduced by the President, Dr. Joseph C. Guernsey, with the following remarks: "It is the custom of our Club to occasionally invite outsiders, that they may enjoy with us some of our rich intellectual feasts; and we

feel that to-night we are offering an exceptionally entertaining and instructive treat in presenting 'Color Photography.' It has been said to me, 'You are a club of microscopists; therefore, what have you to do with color photography?' I shall refer this question to Mr. F. E. Ives, whose persistent investigations of photography in all its branches, extending twenty years, have culminated in the triumph he is about to exhibit to us. Mr. Ives then proceeded to demonstrate the "kromskop" system of recording and reproducing colors by photography, with special reference to its application in pathology. The importance of color in the diagnosis of many diseased conditions, and the desirability of obtaining and preserving for future reference and study the appearance as to color as well as form in many diseased conditions, having long been felt by the medical world. Both upon the screen and in the kromskops, color photographs of pathological subjects were shown, and also examples of a different character, such as landscapes, portraits and works of art. Mr. Ives gave a concise exposition of the principles of the system, explaining the fact that it bore the same relation to color vision that the moving picture apparatus does to life motion, and the phonograph to sound—each system producing in the first instance, not a reproduction of the thing itself, but a record, which was afterwards translated to the eye or ear by means of a special device. A special feature of the demonstration was a description of the methods by which the process, first successfully only as a laboratory experiment, has been reduced to such a degree of simplicity and precision that it is coming into general practical use.—NATHAN SMILIE, M. D. *Secretary.*

NEW PUBLICATIONS.

Detroit Medical Journal.—April witnesses Vol. I, no I of a new 32 pp. periodical. The frontispiece and first ar-

ticle is by our old friend, Dr. W. P. Manton, Editor of *The Microscope* in the days when it thrived in Detroit.

Algae.—A catalogue of 734 publications, with prices in marks, has been issued by W. Junk, Second-Hand Bookseller, Berlin, N. W. 5, Germany, devoted entirely to algæ, diatoms and desmids. I have written for ten copies to send to subscribers who apply therefor. The first ten who apply will receive them and others will be supplied from a later lot, after I see how many are desired.

Hypnotism. By L. W. DeLaurence, Pittsburg, Pa. 8vo. 256 pp. 18 plates. Owing to these beautiful illustrative plates, this is the best book on the subject which we have seen. The book is written for physicians and scholars, as well as others. We do not recommend that others try to use this great but little-understood force in Nature, though there is no harm in reading up the subject. The author goes into the broad field of suggestion and its application in various ways such as in dentistry, mental healing, etc. He treats also that curious topic of self-hypnosis. As regards crime, his statements are important in a Medico-Legal sense. He seeks to connect the doings of Indian fakirs with hypnotism and writes a chapter on magnetic healing. The paper and printing are excellent but the cover a little flashy. The author's picture appears in many of the plates and yet he seems to think that his good-looks warrant it as a frontispiece also. He is rather good looking. His book comes from Hennberry Company, Chicago.

Atoms and Energies. By D. A. Murray. 12 mo. 202 pp. \$1.25. This is the discussion of the elements of physics. The author does not blindly accept the theory of the ether but finds all nature included in (1) an attractive energy such as is seen in gravity, (2) an expansive energy as is shown by heat, (3) what we call matter composed of atoms. With these three, he proceeds to explain cohesion, adhe-

sion, chemical affinity, the solid, liquid and gaseous states of matter, latent heat, the transition from liquid to gas and the expansion of water by freezing. Energy he calls an entity and not a mode of motion. This book is worth the attention of every naturalist and philosopher. Curiously, he finds that atoms are not all of the same size or shape. We shall hear from Mr. Murray again with much satisfaction. He writes from Ottumwa, Iowa. The A. S. Barnes Co. Publishers.

Key to Magnetic Healing.—A handbook for ministers, doctors, lawyers, teachers, students, business men, nurses, and others, by Professor J. H. Strasser, of the New Ulm Inst. of Magnetic Healing. This book comprises the history of magnetic healing, the theories of vital magnetism, mental science, hypnotism and telepathy, and practice of magnetic healing. This book seeks to bring the subject down to common sense avoiding mystery, confusion, superstition. The fundamental principles of magnetic healing are fully demonstrated. This book gives the reader entirely new and higher views about the workings of his own body and mind, and shows how to get well, and how to keep well. It gives the most advanced theory, and the correct practice of magnetic healing. Price \$5.00 with a reduction to our subscribers equaling our subscription.

MICROSCOPICAL QUERIES.

A subscriber writes: "I have made several sections of coal, but have so far been unable to bleach them." Please let us have your experience therein or abstract of any printed instructions to which you have access.

Is there anything I can use to thin the cedar oil without unduly altering its refractive index? I can, indeed, manage with a Rousselet compressorium fitted with very thin cover-glass, but it is not always practicable to transfer a minute object from the slide it happens to be on.

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On the Resolution of *Amphipleura Pellucida*, etc.

With a Dry Lens and Axial Illumination.

A. A. MERLIN, F.R.M.S.

(Read November 16, 1900).

Many members of our Club have been long familiar with the structure of *Amphipleura pellucida* as revealed by oil-immersion objectives of the highest class and aperture. The point to which I now beg to call your attention is the accomplishment of the resolution of normal specimens of this diatom by means of Zeiss's dry 4 mm. apochromat, and a 5-6ths solid axial cone from Powell's adjustable apochromatic condenser.

I was led to attack the *A. pellucida* with the above spec-

ified optical arrangement through having remarked the great strength of the resolution yielded by some realgar-mounted specimens under the Zeiss 3 mm. of N.A. 1.4 and a solid axial cone of about N.A. 1.2 from an oil-immersion condenser. I must confess that the exact theoretical resolving limit of an object glass of N.A. .95, as given in the table on page 85 of Carpenter's "The Microscope and its Revelations" (Seventh Edition, Edited by Dallinger, 1891), had at the time escaped my memory, otherwise it is extremely improbable that any such attempt would have been made.

It was found, however, that in actual practice the 4 mm., used in conjunction with a 27 compensating ocular, with which eyepiece the image remained perfectly sharp, would steadily show the fine transverse striæ on realgar mounts, although the lineation was much fainter than that revealed by oil-immersion lenses of large aperture.

The resolution of valves in realgar having been accomplished, dry and balsamed specimens were next examined, and to my very considerable surprise, both proved resolvable with the 4 mm. and 5-6ths axial cone. In balsam the striæ appeared as extremely faint, but clean, gray lines of great fineness. Although most faint and difficult, they have been held with perfect certainty for short intervals, slightly averted vision proving of material assistance in this instance.

In order to satisfy myself that the true striæ are indeed rendered visible by the 4 mm., a valve has been first arranged to exhibit them under that lens, an oil-immersion being afterwards substituted, when the lines have been found to be identical, and of the same fineness and distance apart with both objectives, the only difference being in the strength of the resolution afforded by them.

The significance of the above results is at once apparent on turning to the aperture table, where we find that N.A. .96 is given as the *limit* of resolution of the *A. pellucida*;

hence it would appear that the Zeiss 4 mm. of N.A. .95 (nominal), illuminated by a 5-6ths solid axial cone, is in practice capable of revealing structure just within the theoretical resolving limit of a lens of N.A. .96, and that this resolution is attainable not only in media of high refractive index, but also in balsam and with dry mounts.

Now the 4 mm., although its guaranteed minimum N. A. is only .95, as a matter of fact is quite likely to possess an N.A. of .96, or even one slightly in excess of this, so that theoretically, without any deduction for technical imperfections, it would be just capable of resolving the *A. pellucida*; but that this theoretical limit should be actually attained by a lens with strictly axial illumination, and on specimens mounted in media of both high and low refractive index, cannot be regarded as a very extraordinary and interesting result, it having been hitherto considered that the transverse striæ of the *A. pellucida* are in actual practice only just discoverable with dry achromatic lenses of N.A. 1.0, and that only on the specimens mounted in a medium of about 2.4 refractive index when illuminated by oblique light in one azimuth along the valve.

Perhaps not the least interesting and satisfactory outcome of these observations is the indication that a dry lens is capable of working its full theoretical capacity on balsam-mounted objects, the resolution only becoming more conspicuous in media of higher refractive index.

In addition to the *A. pellucida* many other forms have been recently studied with the 4 mm. and a 5-6ths solid axial cone. The most difficult structural features have not been seen with a lesser cone, but we do not assert that they may not possibly be so resolved, although the results of my observations have strongly inclined me to the belief that, with axial illumination, structure just within the capacity of the lens employed can only be seen with a very large cone. It has appeared to me that closing down the cone, while greatly strengthening the contrast of the

coarser, causes the finer detail to disappear altogether, and materially reduces the separating power of the objective. With reference to this matter the following experiment may prove interesting:—Arrange a Cherryfield *Navicula rhomboides*, mounted in a mixture of monobromide of naphthaline and balsam, under a good semi-apochromatic $\frac{1}{4}$ " of N.A. .77, and 27 ocular, so that the valve shall lie longitudinally along and on the sharply focussed edge of the lamp flame. With slightly under $\frac{1}{4}$ cone the longitudinal striæ will appear conspicuous throughout the entire length of the valve, while the closer transverse striæ, although they may be seen to a certain extent, are far less satisfactorily defined, no thoroughly clear separation being apparent. Now replace the smaller by a 5-6ths cone. The coarse strongly-defined longitudinal striæ disappear, and at the first glance all structure may seem to have disappeared with them, but a little careful scrutiny will reveal the presence of a faint dotted resolution, the transverse divisions of which are as fully and cleanly shown as the longitudinal.

I am aware that the results dealt with in this paper cannot meet with general acceptance until they receive confirmation at abler hands than mine, nor indeed would it be desirable that they should be so accepted, involving as they do important theoretical considerations, until independent practical experience shall have placed their truth beyond doubt.

The subjoined notes on some of the forms lately examined with the 4 mm. may be of interest. A very large central solid cone has been invariably employed in conjunction with either Gifford's or the beautiful new acetate of copper screen.

Nitzschia curvula Sm. This diatom is mounted next to *Amphipleura pellucida* on Moller's dry "Probe-platte." Transverse striæ close and delicate, but undoubtedly resolved.

Nitzschia sigmatella Grun. Moller's balsam type slide. Transverse striæ extremely faint and difficult. A delicate object even with N.A. 1.3 and 1.4.

Nitzschia linearis and *N. obtusa* Sm. In balsam. The former very faintly resolved into transverse striæ, the latter not so difficult. Dr. H. Van Heurck, in his "Synopsis des Diatomees," gives *N. linearis* as having 27 to 30 striæ in 0.01 mm. (25.399 mm. = 1 inch), and *N. obtusa* 26 to 27 in 0.01 mm. *N. sigmatella* Grun., is given at 25 to 26 striæ in 0.01 mm., but the specimen of this form on the type slide has much finer structure than *N. linearis* and *N. obtusa*.

Nitzschia sigmoides Sm. Moller's dry "Probe-platte"—25½ to 26 striæ in 0.01 mm. according to Van Heurck. This is remarkably easy with the 4 mm., the striæ presenting a beaded appearance. They can be certainly seen with the 12 mm. apochromat of N.A. .65, so do not probably, in this instance, exceed 55,000 to the inch. A specimen in balsam is also very easy with the 4 mm.

Nitzschia sigma Sm. Van Heurck gives 22 striæ in 0.01 mm. Distinctly dotted in balsam, and very easy in mixed monobromide of naphthaline and balsam.

Grammatophora oceanica Ehrenburg. = *G. subtilissima*. Moller's dry "Probe-platte." Resolved into transverse striæ. Van Heurck gives 30 striæ in 1.01 mm. for the *G. oceanica* var. *indica* Grun., and 30 to 31 for the *G. oceanica* var. *novaezeelandiae* Grun. Some specimens of *G. subtilissima*, however, are finer, running at about 88,000 to the inch.

Navicula crassinervis. Striæ 34 to 35 in 0.01 mm. according to Van Heurck. This has proved a most delicate object with the 4 mm., both dry and in realgar. With N.A. 1.3 and 1.4 realgar mounted valves are sharply resolved into dots, but the transverse striæ have alone been seen with the dry lens.

Hyalodiscus subtilis. In a mixture of monobromide of

naphthaline and balsam. Dotted structure on outer zone well seen, although faint and difficult near the edge of the disc. In balsam mounts the structure appears still fainter, but nevertheless may be traced nearly to the outer edge, where it runs at about 76,000 to the inch.

Surirella gemma Ehrbg. In realgar the beading has been seen beautifully defined with the valve arranged longitudinally on the sharply focussed edge of the lamp flame. Specimens mounted dry, in balsam, and in quinine, have been also examined, but their complete resolution has proved a much more difficult matter.

Colletonema vulgare. Moller's balsam type slide. This has been most carefully studied with the 4 mm. The resolution is very faint, and requires particularly exact focal adjustment, but when once seen it can be held fairly steadily without any great difficulty. Dr. Van Heurck writes of this diatom, "Stries fines, délicates, les moyennes faiblement radiantes, les terminales parallèles, environ 34 en 1 c.d.m.; les stries médianes plus fortes, plus écartées, 24 en 1 c.d.m. et plus radiantes."

Navicula major. Moller's balsam type slide. The full resolution of the structure of the bands on the hoop of this diatom is by no means easy, even with the Zeiss 3 mm. apochromat of N.A. 1.4. Notwithstanding this, the resolution is carried very far by the 4 mm., the striæ appearing remarkably black, crisply defined, and well separated, their beaded nature being quite recognizable, although not so fully revealed as with the oil-immersion. On this specimen the striæ alone are just visibly separated by the 12 mm. apochromat, 5-6ths axial cone, and a Huyghenian eyepiece magnifying about 45 times, the 27 compensating ocular not proving sufficiently powerful for the purpose with this objective.

COMMENTS BY DR. E. J. SPITTA.—To enable an object consisting of lines separated by minute intervals, or dots, or any small structures, to be seen, two conditions were

absolutely necessary. First, that such objects should be sufficiently magnified for the eye to be capable of seeing them; and secondly, that the N.A. of the objective should be high enough to render such objects sufficiently resolved; for every one in the room was familiar with the fact that mere magnification without sufficient N.A., or "empty magnification," as Professor Abbe called it, was as useless as N.A. without the proper amount of magnification.

Now with regard to the first condition. It was supposed that 1-250 inch represented the minimum distance that two objects, whether lines or dots, must be separated for the normal human eye to see and separate them distinctly at a distance of ten inches. No lines or dots closer than this could be recognized in their individuality. In other words, no matter what might be the real distance between any two dots or lines on a diatom they must, by optical means, be so rendered to the eye, when looking down the microscope, that they did not appear closer together than 1-250 of an inch. It was more convenient for them to be magnified a little more, so as to be separated apparently by a greater interval, because in that case those whose eyes were not absolutely normal would see them better; but anyhow they must not apparently be separated by an interval of less than 1-250 of an inch. The lines on *Amphipleura pellucida* were mostly about 100,000 to the inch, so to see them with the microscope the entire optical arrangement must result in magnifying at least 400 diameters, because $400 \times 250 = 100,000$. Now, how did the author obtain his magnification, and what was it? He used a $\frac{1}{4}$ in. objective and a 27 eyepiece. Well, that equalled a magnification of 1620, because the initial magnifying power of a $\frac{1}{4}$ in. was about 60, and $60 \times 27 = 1620$. He had, therefore, plenty of magnification. But what about the N.A.—the second condition?

Abbe's law which was based on mathematical considerations admitting of no controversy, declared that, with

the smallest possible beam of truly axial illumination, the number of lines to the inch capable of being resolved = s / λ , where s is the number of wave-lengths to the inch of the light actually used. Putting this into actual figures, seeing that there are about $47,500 \times .95$ gave $45,125$ lines to the inch as the theoretical limit—a long way off 100,000. In other words, the lines must not be closer than $1/45125$ of an inch. But with oblique light this formula was fouled, and became $1/.95$, or 90.15 to the inch, or $1/90250$ of an inch apart. It was evident, then, that Mr. Meritt could not have seen lines 1-100,000 or even $1/90,000$ of an inch apart without oblique light, using only a $1/6$ cone of axial illumination; and this justifies the original remark that his specimen must have been a coarsely marked one. It was theoretically possible that the author might possess a photographic eye, so to speak: one that received impressions in the violet-blue ray as well as ordinary individuals did in the yellow-green or so-called "visual ray," but he had never heard of such a case.

As the formula already given applied to any ray, it should be possible to photograph on a plate what cannot be seen with the eye. The 100,000 lines to the inch could only be seen most faintly with the .95 objective, but inasmuch as the wave-length of photographic light was about $1/62500$ of an inch, twice that $\times .95$ gave a photographic limit of a little over 100,000 lines to the inch. His son, and himself had tried to do this. As they could focus the lines on the ground glass screen of the camera, they had to make trial and error exposures, and failed several times, but at last succeeded in just showing the lines.

Seeing things with a direct solid cone was no doubt very much better and more to be relied upon than seeing them by oblique light. An object with large markings well seen by direct light appeared simply gray with oblique light. If the lens employed was a fine one and the lines were very fine they could be seen with oblique light,

but if they were coarse they were lost sight of by virtue of their largeness.

COMMENTS BY E. M. NELSON.—Mr. Merlin used the telescope, till his eyesight was exceptionally keen, which was probably as good if not better training for the eye than the microscope. The fact of one being unable to see any particular structure described in this paper would not, therefore, be evidence that Mr. Merlin was likely to have been mistaken in what he had seen. He had tried a 5-6th cone with the dry 4 mm. apochromat of .95 N.A. with the $\frac{1}{4}$ -inch wick of a paraffin lamp and an acetate of copper filter, but was not able to effect resolutions to anything like the extent Mr. Merlin had done. He next tried sunlight with a heliostat, but the heliostat proved untrustworthy and the sunlight fickle, so he was not able to push his experiments as far as he would have liked. He found, however, that with sunlight he could use a filter of much greater thickness, and then he was able to see some of the structures. There was another point—viz., that the Abbe diffraction theory did not fit in with all the observed phenomena bearing upon that branch of microscopy. It was highly probable that the large solid axial cone had a greater resolving power in it than was generally supposed. His experience showed him that 80,000 times the N.A. of the objective was the resolving limit in inches with this kind of illumination, but from what Mr. Merlin had said it was evident that a larger coefficient must be employed. The little beads in the lines on the hoop of a *Pinnularia major* were, so far as he knew, unresolvable by oblique light, but with the 5-6ths solid axial cone he had been able to see them with the dry 4 mm. apochromat. Strange to say, this same object had in 1895 been a kind of minimum visible or crucial test for an apo. $\frac{1}{4}$ " of 1.43 N.A. It appeared, therefore, that the "minimum visible," the "crucial test," the "scarcely resolvable detail" of one year became the commonplace object at a

subsequent period. This, Mr. Nelson said, had been his frequent experience during the quarter of a century he had been actively engaged in microscopical work.

Does Rabies Originate Spontaneously?

D. E. SALMON, D. V. M.

Most of the older writers on rabies, those whose writings appeared before 1865, admitted that the disease might develop spontaneously in the bodies of certain animals as a result of certain conditions of life and atmospheric influences. These same writers believed that most other contagious diseases frequently originated in the same manner. It was a time when the spontaneous generation of many living things was frequently admitted, and when the ignorance of the nature of all kinds of contagion, with the exception of the larger animal parasites, was complete and impenetrable. Science had not yet definitely passed upon the doctrine of the spontaneous and continuous generation of living matter.

It was not a very long time before this when it was believed that the mite which causes scabies or itch was continuously developed spontaneously, and that it was folly for people to try to protect themselves from this disease. About the same time, or possibly a little earlier, it was thought that lice were spontaneously developed, and that both the domesticated animals and mankind were doomed to suffer from them for all time. Still earlier there was a common belief that crocodiles and other animal life developed spontaneously from the mud of the rivers and lakes in which they were found.

The study of natural history and the progress of science disproved one by one these ancient beliefs, and made it clear that all animals developed from pre-existing animals of the same kind. Even lice and the mites of scabies were found to be subject to this invariable law of nature,

and the eradication of such pests was taken up with energy and perseverance. The rarity with which these parasitic pests are encountered among civilized people of the present day proves the value of correct views upon such questions.

The last point to be yielded by the believers in spontaneous generation was the origin of the protozoa and bacteria, microscopic animals and plants so small that their life history could be studied only with great difficulty. It was finally shown, however, that even these infinitely small organisms obeyed the general law of nature and propagated and developed from ancestors, each species after its kind, and that in the absence of ancestors not even these low forms of life could appear.

About this time it began to be suspected that the cause of the contagious fevers was microscopic organisms, which were able to live a parasitic life in the bodies of men and the larger animals. After many observations pointing in that direction it was finally demonstrated in 1876 that the cause of anthrax was a bacillus, and shortly afterwards that fowl cholera, septicæmia, hog cholera, tetanus, black-leg, tuberculosis, and various other diseases were due to similar microscopic vegetable organisms, each disease being caused by its own distinct species of germs. It was also shown that malaria, Texas fever, and some other diseases were caused by microscopic animal organisms belonging to the protozoa, and that here again each disease had its own definite and distinct species. In every case the minute plant or animal parasite had its own definite form and certain biological characters by which it might be distinguished from all other living things. Each species multiplies and propagates its kind, and there is no more evidence here than elsewhere in nature to sustain a doctrine of the spontaneous appearance of living things.

The first effect of these scientific demonstrations was to clear away a vast amount of rubbish which had accu-

mulated in the standard teachings as to the cause of contagious diseases. If, for example, anthrax is caused by the *Bacillus anthracis* gaining entrance to the interior of the body and multiplying there, and if the disease cannot be produced in the absence of this bacillus, then it becomes plain that the disease is not caused by electrical disturbances of the atmosphere, by too much food or too little food, by forage containing too much water or that which is too dry, by intense heat of summers or extreme cold of winters, or indeed by any of the other influences to which the development of the disease has been usually attributed. It was contact with substances containing the bacillus which produced the disease, and when this bacillus gained access to the animal body the disease developed without reference to the atmospheric conditions, the food, or the other elements of the environment.

The comprehension of this fact led Bouley and other great pathologists to revise their opinions regarding the origin of many contagious diseases. It had been held that glanders originated spontaneously from overwork and insufficient food; that bovine pleuropneumonia developed as a result of exposure of cattle in the mountains of Europe to extremely low temperatures; that cattle plague arose spontaneously in eastern Europe, and particularly on the steppes of Russia, and that rabies in the dog resulted from unfavorable conditions of life. The demonstration of the germ theory of contagion, which was quite unexpected by the majority of medical men, completely overturned these old views, based upon an entirely different hypothesis. The idea of spontaneous development, of origin *de nova*, was generally abandoned, and the further scientific researches have been pushed, the more incontestible does it appear that the one and only factor of consequence in the production of these diseases is the entrance of the disease germ into the interior of the animal body, where it can multiply and disseminate itself.

If proper measures are taken to protect animals from the bacilli of anthrax, of glanders, of pleuropneumonia, they do not contract these diseases. Investigation of cattle plague in central Europe indicated that the disease always came from the East. Investigations on the steppes of Russia showed that it did not originate there, but came from the plains of Asia. Investigations in Asia indicate that even there the disease is always the result of contagion from some other affected animal. In the same manner, investigations of rabies failed to bring out any evidence to indicate that the disease might originate in any way except by contagion, that is by inoculation from an affected animal. It may, therefore, be accepted as practically certain that rabies does not develop spontaneously in any animal, but that it is always the result of inoculation from some other affected animal.

If the doctrine of spontaneous generation, or abiogenesis, has been abandoned by scientific men, it has by no means lost caste with many persons who consider themselves philosophers; and these persons hesitate to accept or indeed bitterly contest the conclusion of science, which has been outlined above. If, they ask, every dog with rabies contracted the disease from some other dog affected with it, how did the first dog get it? This is a question as to the origin of things, which we may with equal reason ask in regard to all living organisms. If every dog is brought into the world by the sexual union of the two other dogs, where did the first dog come from? This question is just as difficult, but no more difficult than the other. Because we have in our question implied the philosophical absurdity of a series of dogs without a beginning, we have not convinced anyone that dogs can originate in any manner except by ancestors of their own species, nor is the similar question as to the origin of the first case of rabies any better reason for accepting the theory of the spontaneous origin of this disease.

There are many diseases of which it may be said that in our time and in our country they arise only by contagion. Prominent among these are smallpox, scarlet fever, measles, cholera, tuberculosis, glanders, bovine pleuropneumonia, foot-and-mouth disease, and rabies. Recorded history does not tell us where and under what circumstances the first case of any of these diseases appeared, any more than it tells us where and under what circumstances the first dog appeared. We know by observation, and by observation alone, how dogs are propagated at the present day, and we accept observation as conclusive upon this point. Why should we not accept observation and experimentation as conclusive in regard to the propagation of a contagious disease?

While we can not reasonably expect at this late day to decide the cause of contagious diseases by speculation as to the first appearance among animals of such diseases, it is legitimate to make such an inquiry in order to obtain a better understanding of these plagues. Science has made great progress in explaining the origin of species, and even in tracing in general terms the development of life upon earth; and while it can not say definitely where, when, and how the dog originated, it has been made plain that in some prehistoric age the dog developed from some earlier and related animal form, not by a sudden transformation, but by gradual transition. And in the same manner this early ancestor of the dog developed from a still earlier ancestor, doubtless quite different from the dog as he is to-day. To be brief, in tracing the development of the dog, we should be obliged to go back, step by step, toward the dawn of creation, toward simpler and simpler forms of life, until the primordial germ is reached. Just where in this long series of succeeding forms or just when in the countless ages that have elapsed since the beginning of the series the disease known as rabies appeared it is impossible to say. It may have been in

comparatively recent times, and when the dog had arrived at substantially its present form and development, or it may have been in some previous geologic age, when the conditions of environment upon all parts of the earth were far different from what they are at the present day.

It is not to be supposed that the strange animals whose fossil remains prove their existence many thousand years ago were free from contagious diseases any more than are the animals which live to-day; but whether the diseases of the prehistoric animal species were propagated from animal to animal until our time, or whether they disappeared and were replaced by more recent plagues, it is now impossible to say.

A study of the communicable diseases indicates that most if not all of them are caused by parasitic organisms. Indeed, the animal body has become the host of a multitude of parasites, most astonishing because of the number of species and the great variety of forms. All of these parasites probably at one time in the existence of their species, or of the ancestors of their species, lived elsewhere in nature. Under certain conditions they were attracted to certain kinds of animals; they found they could live upon or within them; they adapted themselves to these new conditions; their form and their physiological requirements were gradually changed, until finally in the course of time they could not exist elsewhere. They were then strictly parasitic.

So far has this development and adaptation to the conditions of environment gone that we find different species and varieties of lice, of mites, and of worms living upon each different species of animals, and in most cases these parasites perish if transferred from one species of animals to another species. If, therefore, these parasites can not exist when transferred to a different species of animals from that upon which they have developed and to which they have become adapted, there is all the more

reason why they can not exist in nature elsewhere than upon or within the animal body. Hence, we find animal species living as parasites upon other animals, and having no individuals of their species living a non-parasitic existence. They have developed and have been modified since they began their existence as parasites, just as the species of animals living free in nature have been modified. Consequently, if an animal becomes infected with lice or mites at the present day it must get them from some other animal which bears them.

The adaptation and modification of the bacteria and protozoa which cause the contagious diseases has probably occurred in much the same manner as that of the larger animal parasites which we have been considering. The glanders bacillus has lived a parasitic existence in the bodies of animals of the horse kind for many thousand years. It is no longer able to multiply or live for any considerable time in nature outside of the animal body. It is therefore a strictly parasitic organism. The bacillus of tuberculosis is even further developed as a parasite than the bacillus of glanders, as it is much more difficult to cultivate in the laboratory even under the most carefully adjusted conditions. There is no reason to suppose that any bacilli exist in nature having the same biological characteristics as have the glanders and tuberculosis bacilli.

The exact form of the rabies virus has never been satisfactorily determined, but what we know of it leads to the conclusion that it is a parasitic organism of some kind, which has been modified by thousands of years of existence within the animal body, and which has no counterpart elsewhere in nature. Inoculation with it is easy; it has specialized as to the conditions of life to such an extent that it multiplies only in the brain, spinal cord, nerve trunks, and a few glands; it can not be made to grow outside of the body by any methods now known. All these

facts indicate an obligatory parasitic existence. When or under what conditions in the prehistoric ages of the past it first became parasitic can never be known, nor can we determine at this late day how long a time was required to transform it from an organism which was only occasionally or accidentally parasitic into one which could live no other but a parasitic life. What appears certain is that for more than two thousand years rabies has been the same disease it is to-day ; that it has been propagated by the same species of animals, manifested itself by the same symptoms, and produced the same fatal results.

It is not likely that other microscopic organisms will from time to time take up their habitat in the animal body and become obligatory parasites. There are a number of different bacilli now known which are capable of living in the flesh and causing fatal disease, but which only do this under accidental conditions. Among these are the anthrax bacillus, the bacillus of blackleg, the bacillus of malignant oedema, and the bacillus of tetanus, all of which are deadly in their effects on animals inoculated with them, but all of which lack some quality required for their rapid dissemination or for the ready infection of susceptible animals. Consequently, they do not usually spread from animal to animal. With slight modification the anthrax bacillus might become the most terrible of the known disease germs. But that such modifications require time and conditions not often found, is proved by the fact that though this disease has been known since the beginning of medical knowledge, the bacillus has in the memory of man made no progress as a disease-producing organism, but on the contrary appears less capable to-day of gaining entrance to the tissues than it was two or three centuries ago.—*Ag. Depart. Year Book, 1900.*

Terminology of the Study of Blood Normal, and Abnormal.**HARRY D. OBERT, M. D.**

The blood consists of a liquid basis or plasma, in which are found two great varieties of cells, the red and white. The red ones are termed erythrocytes and the white ones leucocytes. The red cells are bi-concave discs, dark at the edge and with a clear or bright spot in the centre due to their bi-concavity. When this spot shows very distinctly a pathological state exists which we term endo-globular degeneration. There is no nucleus in the red cells. The white ones are nucleated in various manners, according to their stage of development. In addition to the corpuscles, there exists the so-called blood plates. Blood plasma when obtained free from corpuscles is perfectly colorless in thin layers. The red color of the blood is not due therefore to the blood plasma, but is caused by the mass of corpuscles held in suspension.

The blood leucocytes which are by far the most interesting part of the blood to study, are divided up in different classes, depending upon their stage of development. The function of these leucocytes has been the subject of numerous investigations, particularly in connection with blood diseases, but it cannot be said that we possess any positive information as to the normal function of these cells. These cells are not all the same, histologically. Erlich's classification divides them into three groups ; (1) Oxyphiles or Eosinophiles, or those which stain with an acid aniline dye, the acid portion of the dye acting as the stain. (2) Basophiles, those staining with a basic dye. (3) Neutrophiles, those staining with a neutral dye. These white cells are nucleated, with one, two or more nuclei which change their type and may become the so called transitional, the terms then, being mono-nuclear transitional and poly-nuclear. Normally the reaction of the blood is alkaline owing mainly to the alkaline salts and

especially the carbonates of soda, which are dissolved in the plasma.

The specific gravity of human blood in the adult male may vary from 1,041, to 1,067. The number of red blood cells is about 5,000,000 to the cubic millimeter of blood in a healthy adult male, and about 4,500,000 in the healthy female. If this number is exceeded which is very rare, the condition is called Polycythemia; if decreased it is termed, Oligocythemia. One of the most marked instances of the former which occurs, is the very extraordinary increase of red cells which is often met with in cases of congenital cardiac disease in children, amounting to as many as 8,000,000 to the cubic millimeter. A similar increase is seen in Phosphorous poisoning. Beside the ordinary red blood cells, we find in health small red cells supposed to be immature red cells, and called microcytes, while we may at times find very large red cells or Megalocytes. Not only may the red blood cells change but the quantity of their hæmoglobin may also vary. Normal blood should contain 100 per cent, although we may have perfect health with the amount estimated at 85 per cent. This decrease is termed Oligochromaemia. In disease we find more or less marked alternation in the red cells themselves and in their coloring matter. The microcytes and the megalocytes already mentioned may become greatly increased in number. The red cells when they become deformed are termed Poikilocytes. Some red cells, which unlike ordinary red cells possess a nucleus and are capable of amœboid movement are usually given the very confusing name of Normo-blasts. Other cells have been found that contained pigment, or are vacuolized, or again so dim in appearance that they are called shadow corpuscles. The proportion of the white to the red cells in health is about 1 to 500, but a very great variation may occur. Thus after meals the white corpuscles are always increased so that the proportion may be 1 to 150. On the other

hand, after this primary increase they may be decreased and the proportion may be 1 to 800. Time of day is also a factor in producing variation.

The instruments employed to-day for the examination of blood consist essentially of the microscope which is used to determine the quality and the character of the red and white cells, their comparative number and the presence of parasites; the polariscope which is employed in the color test for the purpose of determining the proportion of haemoglobin or in other words, the ability of the corpuscles to carry oxygen to the tissues, or for example, to detect the presence of carbon, mon-oxide-haemoglobin. Last but not less important is the so-called Thoma-Ziess haemocytometer, which is a very delicate instrument used to accurately estimate the number of corpuscles in the blood.

Anaemia, which means a deficiency in blood and is represented or portrayed by two conditions, in one of which the pallor and other symptoms are due to a diminution in the number of red corpuscles, while in the other there is a decrease of haemoglobin in each corpuscle. In regard to the white corpuscles, we can find even more interesting data, since their variation in number, form and character is marked in some diseases. Practically all conditions of the blood which are pathological, represent disease in organs connected with the blood directly or indirectly and do not depend upon primary changes in this liquid, except in rare instances. There are several varieties of anaemia, the most important of which is the so-called Pernicious Anaemia, in that it progressively gets worse until death occurs in the majority of cases, although a few may recover. The pathology of this disease is not understood. It is characterized by marked pallor without loss of flesh, or to speak more correctly, the sub-cutaneous tissues are added to rather than robbed of fat. There are gradually increasing dyspnoea, failure of strength,

cardiac palpation, venous murmurs, some vertigo and tinnitus.

The blood shows a most extraordinary and continually diminishing number of red cells, until the number may amount to only 143,000 to the cubic millimeter. In addition the following points of great diagnostic importance are to be noted. First the individual red cell is richer than normal in Haemoglobin; second, many are larger than normal; third, the red corpuscles are deformed, some being ovoid, others irregular; fourth, there are present microcytes or small cells; fifth, there are nucleated red cells, and, sixth, we may find megalocytes and megaloblasts which have a plain staining nucleus. The megaloblasts are termed corpuscles of Erlich, since he claims that they are Pathognomonic of pernicious anaemia. Anaemia, depending upon lack of Haemoglobin in the corpuscles rather than a decrease in their actual number, is seen most typically in that condition termed Chlorosis. In this disease the corpuscular diminution is so slight that it may be totally ignored, but decrease in haemoglobin is very great.

In connection with anaemia, I may speak of Leukaemia which means a marked increase in white cells, more particularly the large mono-nuclear leucocytes. Pseudo-leukaemia or Hodgkins' disease must be differentiated from true leukaemia, by the blood examination, it being stated that in this malady there is usually but a slight decrease in red cells and no other marked changes.

The parasites of the blood occupy a vast field of study and are held accountable for the different fevers such as malaria, Tertian fever, Quartan fever and the so-called Aestivo-Autumnal fever. These parasites consist for a great part of the malarial germ of Laveran or the "*Haematozoon Malariae*," and the "*Filaria Sanguinis Hominis*." No more important addition to the study of disease from a diagnostic standpoint has been made than the discovery of the presence of a parasite in the blood of

persons suffering from malaria fever, a parasite which is always present under these circumstances, and in all probability acts as the cause of all malarial phenomena. The parasites are varieties of sporozoa which live inside of the cell of the individual attacked. The parasite of malarial fever occurs in three forms, namely, as that of Tertian fever, that of Quartan fever and the parasite of the already mentioned Aestivo-Autumnal. A parasite of Tertian fever is a small Hyaline colorless body which occupies but a slight extent of the interior of the cell. When quiet, the parasite is round like the corpuscle but if examined fresh, it will be seen to have active Amœboid motion. By the terms Tertian and Quartan, we mean as for Tertiana fever which occurs every two days and for Quartan every three days. We may have a double Tertian or in other words, a Quotidian type in which the attack occurs daily. The cause of the paroxysm at a stated time is explained by the fact that when segmentation occurs in the full grown parasite we may look for an attack. The Quotidian fever is explained by the fact that two sets of parasites operate, one set segmenting say to-day, and the other to-morrow. The Quartan parasite which causes an attack every third day in its earlier stage of development, looks very much like that of Tertian form, for it occurs as a small Hyaline Amœboid body filling a fraction of the corpuscle. It soon, however, develops the following differences: first, it develops a sharper outline; second, it is more refractive; third, the Amœboid movement is slower; fourth, the pigment granules are coarser and more important, they lie very quietly around the edge of the parasite; fifth, the corpuscle acts as host and does not increase in size and finally disappears. In the third form of infection, the Aestivo-Autumnal, we find small Hyaline bodies. They have ringed appearance and are sometimes very small. Suddenly this body becomes larger and the ring is lost. Then however an Amœboid movement takes

place and a true ring is formed. The Peripheral circulation in this disease contains very few parasites.

Filaria and by this term we mean a long slender worm-like body existing and swimming in the blood and lymphatics. The "*Filaria sanguinis Hominis*" occurs in three forms. First, the "*Filaria Diurna*" or that species existing by day. Second, the "*Filaria Nocturna*" or that which exists by night, and third, the "*Filaria Perstans*" or that one existing persistently at all times. The "*Filaria Diurna*" and the "*Filaria Perstans*" are confined to patients found on the west coast of Africa and adjoining districts, while the "*Filaria Nocturna*" is pandemic in the tropics, and endemic in certain sections of the United States. The *Filaria Perstans* has been practically proven to be the cause of the so-called fatal "sleeping sickness" of the Congo region.

Prognosis as determined by a blood examination in pneumonia shows in this disease as favorable if Leucocytosis is present, but is a bad sign if absent even in the mild cases and certainly points toward a fatal issue. Leucocytosis simply shows that the system is re-acting.

In diphtheria here again, the absence of Leucocytosis is a bad sign even in the mildest case. The phenomena should keep pace with the severity of the disease. The staining reaction is said to be proportional to the severity of the disease.. Also, in scarlet fever and Scarlatinal nephritis, "Eosinophile" is the good sign and its absence a bad one. As in the before mentioned, the Leucocytosis is proportional to the severity. The foregoing facts simply serve to show that a conservative prognosis should not be made without a thorough blood examination.

The blood corpuscle first makes itself known in the marrow of long bones from whence it passes into those long narrow cylinders the blood vessels, where it must meet its foes, must fight disease, be overcome or return victorious.

BIOLOGICAL NOTES.

L. H. PAMMEL.

MYXOBACTERIA.—Since the publication of Dr. Thaxter's excellent account of Myxobacteria in 1892, several papers dealing with this interesting group of bacteria have been published. The species though mostly American have also been found in Europe and Liberia in Africa. Zukal has found four species of the genus *Ohondromyces* in Vienna. C. Lorrain Smith in a recent number of the *Journal of Botany* describes a *Myxococcus pyriformis* found on the pellets of the rabbit dung. This organism produces pear-shaped cysts of a bright pinkish-orange-color on a short transparent gelatinous stalk. The cocci are round or somewhat oval. The colonies in culture tubes are colorless or dirty white consisting of motile rods. (*Jour. Bot.* 39 : 69-72, 1f).

NEMATODE GALLS ON MARINE ALGÆ.—Ethel S. Barton describes nematode galls found on *Furcellaria fastigiata* and *Chondrus crispus*. Thus far little attention has been given to the subject of gall formation in algæ. The galls form irregular knobs, due to the fact that they exceed or equal in size the diameter of the main stalk. The cells below and around the galls contained small granules which seem to correspond to Van Tieghem's Floridean starch which consists chiefly of Amylodextrin. (*Jour. Bot.* 39 : 49-51, Pl. 418, f. 1-6).

MUSHROOMS.—Much interest has in recent years been manifested in the study of mushrooms in this country, partly because of their undoubted food-value. Hamilton Gibson perhaps did as much as anyone else to popularize the subject. But several botanists have done much to bring the subject before the public in an intelligent way. Among the earlier writers mention may be made of Curtiss, of North Carolina. Of the more recent contributions the valuable papers by Farlow and Peck should be men-

tioned. George F. Atkinson's book on Mushrooms (Studies in American Fungi, Mushrooms edible, poisonous, etc) not only takes up the morphology, but the development and characters by which many species may be recognized. In this book of something over 200 pages the common species are described and illustrated. The pictures are as good as the photographer's art and engraver could make them, and the printer has done his part well. The photographs in many cases show the natural habitat of the fungus. The spore prints and sectional views given show the structure at a glance. Notes on distribution, and whether poisonous or edible accompany the description so far as known to the writer. A good key to North America genera of the family Agaricaceæ and a key for families accompanies the volume, as well as a glossary of the more technical terms used in the work. Mr. Hasselburg furnished the matter applied to certain structural characters of mushrooms. The chapter on chemistry and toxicology was written by J. F. Clark. The recipes for cooking were furnished by Sarah Tyson Rorer. An excellent bulletin on mushrooms has also recently been issued by Prof. L. F. Henderson of the Idaho Agricultural Experiment Station.

EMBRYOLOGICAL STUDIES OF QUERCUS.—Very little work has been done in working out the life history of *Quercus* but Abram H. Conrad, has given us a good account of *Quercus velutina*. The material was quite refractory. Chromo-acetic and picro-acetic acid were the most satisfactory for fixing. Cyanin and Erythrosin proved good for early stages and Delafield's hæmatoxylin for the archesporial stage and fuchsin and iodine green for embryo sac and embryo. (Bot. Gazette, 29 : 408.)

SCLEROTINIA.—Prof. Ralph E. Smith, gives the results of his investigation on *Botrytis* and *Sclerotinia*, their relation to certain plant diseases and to each other. He comes to the conclusion that *Sclerotinia libertiana* and

Botrytis cinerea have no connection whatsoever with each other and that the former species has no conidial stage of this type. It shows at all times a mycelium composed of large branching septate filaments, averaging from 10-15 microns in diameter. Sclerotia are always produced abundantly in cultures and affected plants. The sclerotia are sometimes an inch long. The *Peziza* form is readily produced. The fungus is a good example of a facultative parasite. It attacks a great variety of plants. (Bot. Gazette. 29 : 369.)

STUDIES IN MYXOMYCETES.—E. Jahn in some cytological studies of one of the Myxomycetes, *Dictydium umbilicatum*, obtained best results in fixing with Flemming. He succeeded in obtaining good nuclei by staining with Hæmatoxylin, Safranin and Gentian Violet. He did not succeed in obtaining karyokinetic figures. Chromatin threads and nucleolus can be made out very readily. The *Dictydium* granules described here have not heretofore been recognized in any other group of these organisms. Chemically they are differentiated because of their resistance to acids and alkalies. The chemical nature was not determined. They do not give the chemical reaction for cellulose, though they may prove to consist of substance related to cellulose. (Ber. d. Deutsch Bot. Gesellsch. 19:97.)

TUBER-LIKE BODIES OF CYCAS.—Mr. A. C. Life discusses the tuber-like rootlets of *Cycas revoluta*. The coral-like outgrowths have been known for a considerable length of time and there has been much discussing as to their nature. The author has made cultures of the tubercles on agar and from these he raised three different bacterial forms, an organism resembling the *Rhizobium* of Schneider being obtained. The fungi and bacteria which are in cells in advance of the alga zone seem to prepare the way for the algæ. The author says it is difficult to speak with any certainty with reference to the symbiotic relations which exist between these various or-

ganisms. It has been suggested for certain plants that the converting of free nitrogen and simple nitrogen compounds into the more complex forms used by the plant is due to the nostoc. And the writer suggests the possibility of the use of nostoc forms in the cycads in the assistance of nitrogen assimilation. The tubercles then, have two functions, that of aerating, and that of assisting in nitrogen assimilation. (Bot. Gaz. 31 ; 265.)

MICROSCOPICAL MANIPULATION.

NEW METHOD OF EXAMINING SPUTUM.—Lannuise and Girard (Arch. gen. de Med.) recommended the following method of examining sputum suspected of containing tubercle bacilli. It is based on the property possessed by the alkaline hypochlorites of dissolving mucous matter without the aid of heat. The sputum is put into a conical vessel, and covered by about 10 times its volume of a 33 per cent solution of chlorinated soda, and the whole well stirred up. It is then set aside for 24 hours, being given an energetic agitation from time to time. The disengagement of chlorine commences at once, and in 20 minutes globules of mucus and of pus (should the latter be present) are dissolved, the liquid becoming more or less turbid from the matters held in suspension. At the end of the time named, however, the suspended matter will have settled in the conical point and the supernatant clear liquid may be drawn off with a pipette. If a centrifugal separator is at hand, the operator can, of course, save himself the delay by operating on a single tube several times, decanting each time. When the volume of the material has been reduced to 2 or 3 c.c. there is added 5 or 6 drops of normal solution of sodium or potassium hydrate, (40 grams of NaOH or 56 grams of KOH to the liter of water). This transforms the residual chlorine into a chloride of sodium or potassium, as the case may be.

The mixture is allowed to stand, and the supernatant decanted. This leaves the material in condition to be fixed and stained by the processes of Zeihl or Ehrlich.

THE MICROSCOPIC EXHIBIT OF THE N. Y. BOTANICAL GARDEN.—This unique exhibit, both conceived and presented by Mr. William E. Dodge, has been temporarily installed in the hall of the west wing, and at present consists of twenty-four microscopes of special design mounted, by pairs, on twelve specially built oak stands, costing \$665.50. As this collection occupies a hall otherwise containing only cryptogams, it was decided to restrict the objects shown by the microscopes to specimens selected from the plants below the spermatophytes; thus the microscope exhibit enables a visitor to see the minute structure of the principal groups of the lower plants, from the myxomycetes or slime-moulds to the fern inclusive. Each microscope is accompanied by an explanatory label referring to the object shown by the instrument.

MEDICAL MICROSCOPY.

SARCOMA.—At the N. Y. Academy of Medicine, March 27th, Dr. Jonathan Wright said that the clinical history was entirely opposed to a diagnosis of melanotic sarcoma, as this was a specially malignant form of sarcoma. He had seen a number of apparent sarcomata of the septum in which, so far as the microscopical examination had gone, there had been nothing to distinguish them from malignant growths. In some of these cases the growth had been simply shaved off, and there had been no return. Where the clinical history contradicted the microscope in cases of suspected sarcomatous malignancy, he preferred to rely upon the clinical diagnosis.

SEA-WEEDS.—*Tabulæ Phycologicæ* by Fr. T. Kuetzing, in 19 vols. and index, has 1900 finely colored plates and sells for \$500. A Leipzig book-seller, whose address we

can give when requested by postal card, has undertaken to reprint volumes I-V, which alone are out of print, so as to sell complete sets for \$125. provided a certain number of orders appear. Kuetzing's unique work is the greatest in existence on this subject and is indispensable for the study of sea-weeds. Our readers should seek to influence wealthy libraries in the U. S., to supply our country with at least a few copies,—especially the Boston Society of Natural History; the Astor Library, New York; the Congressional Library, Washington; the Lloyd Library, Cincinnati; the Chicago University; the Mechanics Institute Library, San Francisco; the Carnegie Library, Pittsburg; the Fish Commission, Washington, D. C., etc. We will receive the orders for it in America.

MICROSCOPICAL SOCIETIES.

QUEKETT MICROSCOPICAL CLUB.—The 387th meeting was held on Friday, May 17. Among the donations announced was one of 51 mounted specimens of Rotifers, presented by Mr. C. Rousselet, for which a special vote of thanks was passed. The collection of these organisms now in the club's cabinets amounts to 250, and, as type specimens, are invaluable for study. Mr. Massee gave a description of the life-history of several new fungi belonging to the Laboulbeniaceæ, recently discovered by Dr. Thaxter, U. S. A. They are mostly found growing on aquatic larvæ, chiefly coleopterous. The affinities of this group, especially in their reproductive organs, with the red algæ, was pointed out and illustrated by a number of colored diagrams. The meeting then resolved into the usual conversazione, at which several interesting living organisms were shown, including *Stephanoceros*, *Vorticella*, *Volvox*, and others.

The Club contains 340 members of whom A. M. Edwards, M. D., and Prof. H. L. Smith, of Hobart College,

are Honorary ; S. W. Fletcher, M. D., Pepperill, Mass., and D. Bryce Scott of Moncton, N. B are Ordinary.

NEW PUBLICATIONS.

Das Mikroskop in Chemischen Laboratorium. By Dr. F. Rinne, 74 pp. 202 figs. 4 marks. Hanover. Optical properties of crystals and mineralogical microscopy get excellent treatment. Polarization and micro-methods are described in the German language.

Die Technik des Modernen Mikroskopes. By Dr. W. Kaiser, 80 pp. in each of two parts, 4 marks. Vienna. Instruments of German and Austrian makers are fully discussed. Optics and mechanics in these two parts are to be followed later by other topics. Great advances have been made by Viennese firms of Reichert, Merker and Ebeling since 1880.

Strasberger's Botany. Fifth Edition translated by Hillhouse, issued in London, 1900, 519 pp. 162 figs.

An Astrology.—By A. Alpheus. 217 pp. 12 mo. Until within a century or two, physicians always used astrology and they used it more than all other people but astronomers used it also. The great Kepler used it and was non-plussed because he failed in an attempt to predict the death of Wallenstein. The position of Uranus is now said to have caused it, but Uranus had not been discovered in Kepler's time and had to be left out of his calculations. One of the most eminent physicians of Boston secretly uses astrology and told this author during the first hour of acquaintance that this author, then totally ignorant of the subject, that he would become a leader in astrology. This book in small compass, opens the whole subject, is beautifully bound and will be sent with the Microscopical Journal of 1901 for two dollars. You cannot afford in ignorance to ignore the matter.

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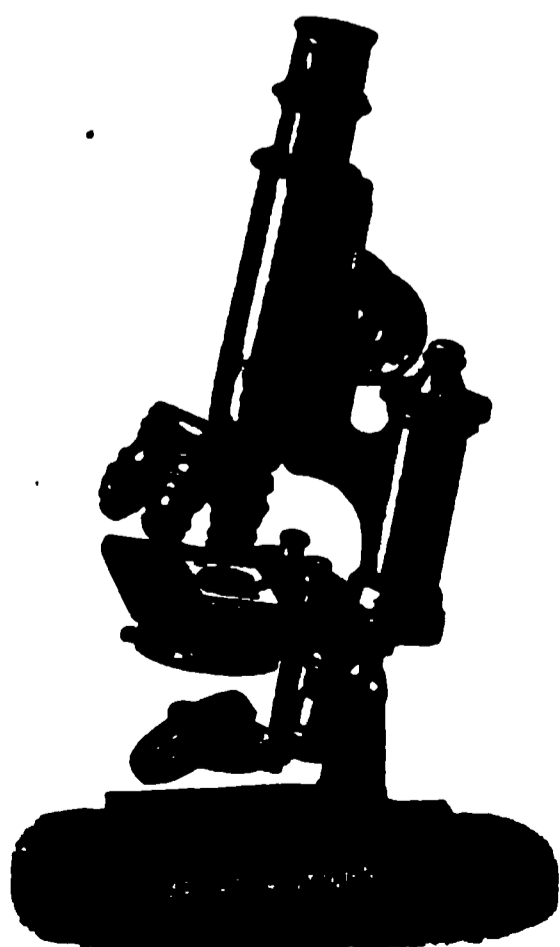
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Comparison of Samples of White Arsenic.

EDWARD BARTOW.

With Frontispiece.

In a recent case of suspected poisoning in this state, a bottle of malted milk was brought to me for examination. I found evidence of the presence of arsenic by the Marsh test, and by the Reinsch test; and even the simple test of heating the substance with a piece of charcoal, in a glass tube closed at one end, gave a heavy arsenic mirror.

Considering the greasy nature of the material under examination, I conceived the idea of separating the crystals of white arsenic, if the arsenic should be present in that form, by means of ether. On panning the malted milk with ether in a shallow porcelain dish, I was enabled to

separate quantities of the crystals in a pure state. An attempt to do this with water failed. In fact, water could not be used on them until they were free from the fat.

A few crystals of white arsenic were separated from a bottle of whiskey found on the premises of the deceased.

In following up a clue that seemed to point to the source from which the poison might have been obtained, the county attorney submitted to me a sample of white arsenic crystals obtained from this source. He requested me to determine whether they were like those found in the malt-

ed milk or in the whiskey. To my knowledge, the only work of such a nature is that of Professor E. S. Dana. Professor Dana enters into an exhaustive account of the methods of preparing white arsenic, and of the possibilities of differences due to the variations of the conditions during the process. He also made microscopical examinations of many samples of commercial arsenic, and deduced the following conclusions: "The study of a large number of independent samples of commercial white arsenic confirms the conclusions based upon the observations

as to the method of manufacture, and shows that wide variations in character often exists. These differences, when they occur, are readily distinguishable by the microscope and, in most every case, it is, by this means, possible to conclude, of two test samples, whether they could or could not have come from the same source ; and this is true, under favorable conditions, even if one of the samples has been subjected, for some time, to the action of the stomach."

The work of Professor Dana is well known, but at first I had only at command the limited notice given to it in

the works on toxicology. Later I received the article of Professor Dana, which he kindly sent me, and was interested in carrying out more in detail the methods of work which he describes. My method of work was as follows :

I mounted a few slides of each of the samples (the limited amount of crystals separated from the whiskey made but one slide) as well as samples of white arsenic from the laboratories of the university and from the drug stores of the city. Differences were so marked that I at once concluded that the sample submitted by the county at-

torney and the arsenic from the malted milk could not have had the same source. To assure myself that the treatment with ether had not changed the character of the crystals from the malted milk, I mixed some of the arsenic from the suspected source with pure malted milk, using the same proportions as were found in the malted milk containing the poison, then panned out the arsenic in the same manner as from the original sample of malted milk. Several slides were made with the arsenic treated in this

way. After the process there was no difference in the appearance of the sample.

In the microscopical examination, I noted the size of the crystals, the size of the amorphous bodies present, the character of the amorphous bodies, and the relative number of crystals and amorphous bodies. We may thus summarize the observations of the crystals from the milk, the whiskey, and the suspected sample. The crystals from the suspected sample were the smallest, those from the whiskey were the largest, though not much larger than those from the malted milk. The amorphous bodies were

of a similar size in each sample. In each case were some much larger than the crystalline bodies. Those from the milk were of a transparent nature, while the others were opaque. In the suspected sample, about 25 per cent were well shaped crystals. In the sample from the whiskey about 15 per cent were crystals. That from the malted milk showed about 40 per cent of crystals. From these differences I concluded that the arsenic in the suspected sample could not have had the same source as that found in the milk and the whiskey.

Amorphous arsenic from pharmacy. x 75.

In order to be sure that my separation of the various slides into groups was not due to my familiarity with them, I submitted these slides, together with slides prepared from arsenic from other sources, to Professor S. W. Williston, to Professor W. C. Stevens, and to Professor E. Haworth. Each had no difficulty in separating the slides submitted into groups, always putting those from the same source into the same group, and never classifying the suspected sample with the specimens from the milk and the whiskey, thus confirming my own conclusions.

All the comparisons were made directly from the slides, and, in fact, a better judgment can be formed by observing a considerable portion of each slide. I have, however, had a number of photo-micrographs made by Mr. F. E. Marcy the university photographer. These show the crystals magnified seventy-five diameters and give a very good illustration of the variations in the various samples. I have added also photographs of samples from specimens of white arsenic in the chemistry and pharmacy laboratories of the university, because they show a great variation in the percentage of crystals, though the particles are nearly of the same size.—*Kans. Univ. Quarterly*.

“Sketch of Thomas Henry Huxley.”

By T. Chalmers Mitchell of London. 297 pp. 8 vo, 6 plates including portraits of Huxley, Darwin, Charles Lyell and Jos. Dalton Hooker.

Huxley was born May 4, 1825 and died June 29, 1895. From 17 to 20, he studied medicine and, in 1846, sailed on Her Majesty's Gun-ship, Rattlesnake for the Australian seas. Though only its surgeon, he became in reality its Naturalist and through the study of minute forms became at this early age a skilled microscopist. This book, therefore, appeals to every owner of an instrument. Besides, it is published by Putman's Sons in their best style at a fair price (\$1.50). Huxley, at 60, told the boys in the Royal College of Science that when he was of their age he had to have his microscope lashed to the mast to get a glimpse of the forms that he was exhibiting to them in slides prepared at Naples. He said, however, that the difficulties of the past were often exaggerated, that with good light and a good lens together with the ship tolerably steady he never failed to get all the facts he sought, that the great thing was the good supply of specimens day after day because delicate oceanic forms deteriorated so rapidly. He did not mind the cramped quarters, the tiny cabin, the jostle of ship's crew, the absence of books,

the lack of instruction or of learned companions. He had the sense to see and to rejoice in the advantages offered thereby. When Huxley cruised, the microtome was unknown. But tissues of animals too large to be examined or too opaque were either teased by needles which destroy the setting or were sliced by razors in a coarse manner. This was tedious and necessitated skill else considerable portions would be destroyed, misplaced or mutilated. But Huxley did more, be it known, through surmounting these obstacles than the army of highly pampered students of today who are provided with Minot's giant microtome, plus many accessories, by means of which tissues are embedded, hardened, cut to an incredible thinness and furnished in series of 100 or 500 sections. The study of forms has been revolutionized, and new methods require volumes for their obituaries since they pass away to make room for others. Our boys stuff their heads in college with the thoughts and methods of other men and all to little account. Huxley at 22, on the war vessel, did effective work which fools have said was due to genius though they have never told us the source of genius. Study and imitate Huxley, oh boy of poverty and of mediocrity, as portrayed by this writer rather than in the volumes from which he has segregated the data and you will see that latent genius is yours, that "self-reliance" is the father of genius and patient absorption its mother.

While Huxley had and genius possesses "self-reliance" it does not include self-esteem and self-indulgence. Self-reliance is an unconscious reliance upon a certain not-self within. Genius always alights upon the banner of that man. Huxley never accomplished anything with a homogeneous oil-immersion, one-tenth. His soul qualities did not require such a tool. An oil-immersion has NEVER enabled a man to get wisdom or a reputation from genius, since he would then rely on the lens and not on intuition. Huxley was driven, on the Rattlesnake, to rely on a some-

thing which I call intuition and which the world has called genius. Here is a lesson for every young microscopist and every naturalist who will study this volume.

Huxley became president of the Royal Microscopical Society but he never "fought lenses." The world will never know him as a microscopist, but the microscopists will always claim him. Of course, if he COULD have used modern lenses and appliances without the sacrifice of any advantage he possessed, his discoveries would have been far greater. For example, with all his study of *Medusæ*, he was never able to discover its nervous system which the highest powers now reveal.

We are told that Huxley was not in any sense of the word a collecting naturalist nor did the naming and classifying of species interest him. In such practices, lays the key to the insignificance of nearly all American college professors and the waste of time by all her students. Huxley wanted to examine "the architectural and engineering part of the business ; the working out of the wonderful unity of plan in thousands of diverse constructions, and the modifications of similar apparatuses to serve different ends."

Of Huxley's magnificent contributions to the up-rooting of theological dogma, this is not the place to speak and those interested are referred to Mitchell's sketch which is so sensible, so just and so free from abstruse technicalities that every boy of sixteen who takes kindly to Nature should be presented with a copy at the same time that he acquires a microscope. While Huxley was a prominent contributor to the *Quarterly Journal of Microscopical Science* he was a true philosopher. While he was not a churchman, he saw the Infinite Omnipresence in nature and adored it.



We are taking subscriptions to Kutzing's 19-volume work (1900 plates) on the Sea-weeds. Send for circular. C. W. S.

British Versus Continental Microscopes.

M. I. CROSS.

For accurate original research, where the worker has some understanding of the mechanical and optical means at his disposal, there is no microscope in the world to be compared with the best of those produced by the leading British houses. In them are to be found refinements of mechanical skill which, suitably employed, call forth a response from objectives and condensers which causes them to yield their very best effects. Even in the British models of medium size and modest cost there are to be found several that are but slightly less effective than the largest, and with which no Continental stand can vie.

Yet the British microscope plays but an insignificant part, numerically, in the world's supply. In laboratories and in places where microscopes are largely used, the Continental instrument holds sway and seems likely to maintain it, at any rate for the present. The question of price is not the factor in the existing state of things, for even in students' stands the British manufacturer keeps his rates at the competitive mark. Why then is it that he does not receive a larger share of appreciation and home support?

The reasons usually given appear to be two in number, and are— (1). The British microscope exceeds the needs of the laboratory worker and student; (2). The casing and general "fit up" is inferior. The first is distinctly a laboratory cry, and may be regarded as due to want of appreciation and education in matters microscopical. The second is more general in its application and in a lesser degree influential.

To do the largest amount of work in the least possible time with the most cut and dried materials is a spirit which pervades the present day, and it applies to microscopical as much as to other spheres of activity.

The laboratory worker wants as much done for him as possible, so that it may only be necessary for him to place his object on the stage and "spot" the structure. To get the best from lenses and condenser is not in his province. "Numerical aperture," "aplanatic cone," and "critical image" are, as a rule, vague terms to him. Hence it comes that an instrument that always has its substage condenser approximately focussed and centred, and the mirror fixed in the line of the optical axis, saves him time and bother and suits his methods of working.

No one can defend the use of what are in reality but rough and ready means of examination of structure, and no reliance can be placed on deductions made from such methods. We are among those who are sanguine enough to hope that in the no very distant future, the advantage of perfect control in manipulation, and a rigid tripod foot, as provided in the majority of British microscopes, will supersede the Continental model.

This can only be brought about by a demand for more thorough teaching of microscopical principles and manipulation, and if good work is to be done in English laboratories it should be seen to that those who use the instruments shall get the best possible out of them. If this necessity were recognized and taken up vigorously by the scientific world—and many know full well how much it is needed—a different state of things would in time prevail. We would not advocate the pandering to a low degree of appreciation by reducing either the calibre or working accuracies of the instrument. Let us all do our best to raise the users to a higher level.

Meanwhile, the British manufacturer has opportunities of making his instruments more acceptable in several ways, and especially in the casing and general "fit up."

A great improvement has taken place in recent years, but there is yet room for further effort. Generally speaking, British houses are inferior to their Continental rivals

in this respect. It must be remembered that the horse-shoe foot is more easily gripped and held firmly in its case than the tripod, but a strong and neat fitting for the latter ought not to be beyond the powers of the ingenious to contrive.

It may be fearlessly stated that a good day is coming yet for British microscopes if the makers do but set their houses in order, and in addition to providing the most sound and accurate instrument that can be, they give due consideration to every detail which will make them acceptable to those who are influenced by appearance. There is no disgrace in making a microscope and its case ornamental as well as useful.—*Knowledge*.

Microscopical Notes.

M. J. CROSS.

For Knowledge.

STAINING LIVING BACILLI.—We have had placed in our hands an interesting paper by Mons. A. Certes dealing with the selective coloring power of the spore-bearing filaments of the *living Spirobacillus gigas* with methylene blue, and the following is a brief *resume* of it.

He remarks that the experiments of Brandt, Henneguy and himself, dating from 1881, prove that living protoplasm can absorb certain aniline colors, but little has been done by biologists in the study of the action of coloring substances on living microbes. It has been found that certain microbes cease to live on being stained, others absorb the stain and still remain alive, while others do not absorb the stain either alive or dead.

The difficulty of making observations on selective coloration is obvious on such delicate subjects as bacteria, but M. Certes was fortunate in discovering the *Spirobacillus gigas* in the reservoirs at Aden; the length of these is usually 150-160 mikrons, but they are occasionally found 400 mikrons long.

These organisms placed in a weak solution of methylene blue continue to move about with the same activity as before, and the stained specimens can be preserved alive until the following day if care be taken not to exclude oxygen.

The effect of the stain varies according to the stage of development of the bacilli. During the first two or three days the living specimens are entirely and uniformly stained in blue exactly like dead specimens.

When the period of sporulation commences, alongside of the totally stained bacilli, the presence of bacilli of different shapes is observed, partially stained and much more clearly. In the same specimens are colored rings in juxtaposition to uncolored rings, grouped in the most varied manner and without any apparent fixed rule.

The spore-bearing individuals which appear a little after, give the clue to these selective coloration phenomena, which acquire a still greater clearness when the specimens are larger—as the turns of the spiral are less serrated, and the spore-bearing bacilli move more slowly in zig-zig fashion. One sees, therefore, that the spores, while refractive, have, except in rare cases, absorbed the coloring matter and that the filaments which carry them are, in general, more feebly colored, some times even uncolored, and that in those specimens whose spores are localized at one extremity on a fixed point on the filament, the rings which carry the spores are almost always uncolored.

Success largely depends on the coloring re-agents that are used. The finest quality of Ehrlich's blue and the chemically pure methylene blue of Grubler and Höchst in very weak solution are recommended, and they should be used at the precise moment when the first sporule-bearing individuals appear.

These phenomena are only visible in the living state; dead specimens stain so rapidly and uniformly that it is extremely difficult to obtain preparations in which the

differentiated coloration is plainly or distinctly visible.

SUBSTAGE CONDENSERS.—It is gratifying to observe the number of first-class substage condensers that are offered by manufacturers, and it is a distinct indication of growing knowledge and appreciation of good things on the part of workers.

It was at one time an easy matter to make a choice when only two or three systems were available, but it is evidently presenting some complexity now, and in response to correspondents' enquiries we propose to give a few hints on the subject.

The main features of a condenser are: (1) *The achromatism*, (2) *aplanatism*, (3) *magnifying power*, and (4) *the size of the fixed lens*.

Achromatism and *aplanatism* can be considered together, but the latter is more important. Recognizing this, there is a tendency on the part of makers to claim greater aplanatism than is actually yielded; this can however, easily be verified by the methods described in the text-books. Achromatism is a desirable quality but we doubt the advantage of an apochromatic over an achromatic condenser; we would as readily work with the latter as the former provided the aplanatism were as well corrected, and this is frequently the case. Expense may therefore be avoided without loss of efficiency in this respect. The solid illuminating cone that an objective will bear has been frequently discussed. It is generally stated that three-fourths the full aperture is the best, but it will be found that the majority of lenses will not bear more than two-thirds without deteriorating in performance; there are some exceptional ones that will take more than a three-quarter cone, but this is not the rule, and a light filter is usually requisite.

The Power.—The magnifying power of the condenser should not exceed half that of the objective, less rather than more than half is always preferable. Many systems

are arranged to work satisfactorily with the front lens removed, and by this means high and low power effects are secured in one combination.

Size of field lens.—The reason for the popularity of the Abbe illuminator, with its glaring imperfections, is on account of its large field lens and the ease with which it can be worked. A high power condenser must of necessity have comparatively small lenses, and requires as great care in manipulating as the objective itself. The Abbe achromatic condenser was an attempt to maintain the easy working of the Abbe illuminator in a corrected form, but it is really too heavy and clumsy and restricts the movements of a mechanical stage. The best condensers have, as a rule, the largest field lenses that can be advantageously fitted, but this point is deserving of special consideration when making a decision.

Recommendations.—From the foregoing it will be possible, with given objectives and a maker's catalogue, to choose the most suitable condensers. If a man proposes to restrict himself to low and medium powers, not exceeding say $\frac{1}{2}$ in., he can readily make a choice, and we would like to specifically mention the new condenser introduced by Mr. C. Baker, of 244, High Holborn: in this a specially large field lens is provided; the power (4-10 in.) is exactly the right one for histologists and workers with medium power objectives, while the aplanatic aperture closely approaches .90. We have found it most effective in some work we have been doing recently, and great credit is due to the maker for its introduction.

The worker who does not go beyond an aperture of 1.25 can do all that his lens will permit with a dry condenser having the nominal aperture of 1.0 and yielding an aplanatic cone of .90 as several of them do. If higher apertures are used, an oil immersion condenser is necessary. This advice has an appalling sound, but it is too little recognized that such systems can usually be worked dry, and

will then give an aplanatic cone exceeding $\cdot 90$. Such is the case with Watson & Son's holoscopic condenser. Again, the top lens can be removed and a condenser of low power secured. Oil immersion condensers are too little appreciated, and it will be found, if it is desired to work with medium and high powers, that the oil immersion system will serve every purpose and is practically a universal condenser.

ILLUMINATION WITH ARTIFICIAL LIGHT.—The lamp that has proved most universally satisfactory is the regular one sold for microscopical work, with a $\frac{1}{2}$ -inch or $\frac{3}{8}$ -inch wick, but to many people this is objectionable for several reasons, the chief of which is that with the general use of gas and electric light, a mineral oil is not kept in the house, excepting for this special lamp; it also is not clean to handle, and requires a certain amount of attention; also it is not always immediately ready for service when required. In laboratories, such a lamp is out of the question, and bare gas jets, or gas jets with upright chimneys, are generally to be found.

I have recently been making some experiments with gas and electric lamps to see if some practical form of illuminant, always available for use without special preparation, cannot be devised for critical microscopical work.

Two important considerations have to be kept in view, one is that the light must be brilliant, and the other is that it should be possible to focus an image of the source of light by means of the substage condenser, in the field of view.

A very serviceable illumination can be secured with the Welsbach incandescent gas light, but the reticulations of the mantle are an obvious objection, and the flame has too large a surface. These can be overcome by means of a shade of metal surrounding the chimney at a distance of three or four inches. In this shade, a small rectangular or circular slot should be perforated. When working,

this slot would be treated as the source of light and focussed accordingly.

At a recent meeting of the Royal Microscopical Society, Mr. Rousselet exhibited an incandescent electric lamp of the Edison and Swan "Focus" type, which has a somewhat coarse filament not unlike a corkscrew suspended horizontally in the bulb. This lamp gives an intensely brilliant light, and it has on many occasions been used for magic lantern purposes. It was recommended that the light for microscopical work should be taken from the edge of the filament and focussed in the same manner as the wick of an oil lamp. The light arranged in this way was, however, to my mind too much diffused, notwithstanding that a shade was used. On making further inquiry I find that a stand for an electric lamp is made for laryngological and aural examinations which has joints and movements for adjusting in any desired position. In the usual type it carries an ordinary eight or sixteen candle-power lamp, but it will quite well carry the "Focus" pattern. If now an enclosing shade be provided similar to that described for the Welsbach light above, with an aperture which can be treated as the source of illumination, an ideal electric light for microscopy is secured. This would answer well also for photo-micrography.

A lamp, somewhat similar to the foregoing, has been used by me with considerable satisfaction, though long usage has created a distinct prejudice in favor of the $\frac{1}{2}$ -in. wick oil lamp.

All workers have not electric current available so this will not appeal to them, but the majority have gas, and where oil lamps are objected to, I would advise a trial of the Welsbach light arranged as described above.

PHOTO-MICROGRAPHY WITH ARC LAMP.—Trouble is invariably experienced in maintaining the light in one central position, and several devices have been resorted to in order to control this. No automatic lamp is really use-

ful for the purpose. A hand-fed lamp must be employed. When this is properly adjusted and the condensing lens is in position, a luminous disc will be seen upon the leaves of the partially closed Iris diaphragm of the substage condenser. During an exposure it will only be necessary to maintain this disc in a fixed position by turning the milled head of the lamp very gently as required, and the light may be kept perfectly central for any length of time. It is presumed that a horizontal camera would be used.

STAINING FLAGELLA.—The preparation of Bacteria so as to exhibit flagella has always seemed to be unsatisfactory and difficult. Very few workers are really successful and none have produced permanent mounts. An interesting note occurs in the Thompson Yates Laboratories Report, by Dr. MacConkey, which deserves consideration.

It has been considered essential when staining such preparations to use a mordant, presumably to fix the dye in the substance of the flagellum. It is suggested that the rendering visible of the flagella in consequence of the use of the mordant is not because of the effect which it has hitherto been credited with producing, so much as by causing the flagellum to swell and become thicker. The flagella are of exquisite tenuity, so much so, that when stained, the dyes do not seem to render them visible to the same extent as when a so-called mordant is used. The suggestion put forward is confirmed by the statement that the flagella appear to be thicker than they are supposed to be actually, and the organisms themselves are larger after the use of a mordant than when stained in the ordinary way.

There are dyes which have the effect of staining the flagella deeply and producing a thickening, but it is observed that, as these colors fade, the flagella become increasingly fine until at last they are no longer visible.

This is a subject in which, to the ordinary microscopist, few opportunities are afforded of making experiments

a good service would be rendered if some really definite and permanent process, based on an understood system, could be formulated.

FINE ADJUSTMENTS.—In the details of the construction of microscopes, as in fact in every other instrument or machine, there is no real finality, and each year sees the introduction of some slight improvement which may tend to make work easier and more accurate. A study of the catalogues of the various microscope manufacturers of a year or two ago will afford food for reflection, for nearly every noted maker then expressed his unbounded confidence in his particular form of fine adjustment. One states that his “must be considered to be a triumph of mechanical skill,” another “has proved absolutely satisfactory,” and a third “its reliability is unsurpassed.” Yet within the space of a few months nearly all the leading makers found it desirable to introduce new devices for fine adjustments. All of them have distinctive features, indicating that care and consideration have been given to their design, and it will probably prove of interest to readers to be made acquainted with such particulars as I have been able to collect from the various makers, for every new idea which enables the worker to manipulate more precisely than available means have permitted him formerly to do, should receive both consideration and recommendation.

A perusal of the paper read before the Royal Microscopical Society, by Mr. E. M. Nelson, and reported in the Society's *Journal* for August, 1899, on the “Evolution of the Fine Adjustment,” conveys some idea of the gradual improvement that has taken place in the movement.

Those who use a substage condenser giving a small applanatic cone will probably not feel the necessity of a better fine adjustment than that which is usually fitted to student's stands having the direct pillar action.

Directly an illuminating cone bearing a fair proportion

to the numerical aperture of the objective is used, the necessity for a slow and precise movement by fine adjustment becomes overwhelmingly apparent.

In a previous article we referred to the fact that many new substage condensers yielding large cones of illumination had been recently introduced, and as the supply of such articles must indicate a demand, it necessarily follows that the people who have used them have discovered the weakness in the fine adjustments of their instruments, have called for something better, and response is being made by manufacturers to meet this fresh demand.

There are four new fine adjustments which I propose to review, as follows:—The Continental pillar fine adjustment with levers, designed by Reichert, of Vienna; the new fine adjustment fitted to their photo-micrographic stand, by Zeiss; the "Ariston," by Swift and Sons; and Stringer's fine adjustment, by W. Watson and Sons.

REICHERT'S FINE ADJUSTMENT.—The great weakness of the Continental pillar form of fine adjustment has been consequent principally on the difficulty of producing a sufficiently slow rate of movement with a direct-acting screw that would stand wear and tear. The problem has been met by Reichert's device, which consists of a screw, having a point which engages two lever arms, the upper pressing upon the lower, and being mounted from the outer sides of the pillar. To the under sides of these levers is attached a piece of hemispherically shaped metal, which has on its curved side a point which communicates the motion. A reference to the illustration in his catalogue makes this otherwise obscure description quite clear, and it will be further seen that the rate of movement is diminished by the proportions of the lever arms, which are about $2\frac{1}{2} : 1$. This would mean that if a screw of the ordinary kind were used, the rate would be reduced to 1-250 in. for each revolution instead of 1-100 as in the old pattern.

THE MICROSCOPE AND THE PHARMACEUTICAL CHEMIST.—To the busy medical practitioner, reference to the microscope for diagnostic purposes is a matter of every-day occurrence. Those who have not the time or disposition to do the work themselves, have at their disposal associations and laboratories which cater to their special needs. In addition to these facilities, it is becoming usual for pharmaceutical chemists to make themselves acquainted with the wants of medical men in these respects, and to be prepared to make the examinations, and to provide themselves with the necessary modern apparatus for so doing.

The microscope is becoming increasingly important in the curriculum of the pharmaceutical student, and it is in no small degree due to this profession that so many of our food and drugs that once were adulterated, are now purer and of better quality. Powdered drugs and spices were frequently mixed with starches, flour, etc., but the microscope quickly discloses such foreign materials. The knowledge of active constituents and other cell contents of medicinal plants, and their distribution in different tissues and organs is becoming increasingly comprehensive and accurate, and experiments aided by the use of special micro-chemical reagents are in progress to identify the vegetable alkaloids and related substances microscopically.

It is satisfaction to know that work of so thorough a nature is in progress, and it is a guarantee that with increased and more general expert knowledge, our food, drugs, and other commodities will be purer and finer than they have been.

THE WORKSHOPS OF E. LEITZ, WETZLAR.—A correspondent sends a description of his visit to the microscope factory of this noted optician. The following is a short resumé:—

The output of this house is 5,000 microscopes per annum, leading one almost breathlessly to ask "What becomes of

them all?" Leitz's great feature is that he confines himself entirely to microscopes and their accessories, instead of producing scientific instruments of every description as English opticians generally do. Herein lies his success.

With a large and regular demand for certain fixed models, a system of production in which machinery plays an important part is possible, and ensures sound construction with a minimum of cost. The supervising and testing departments are of the most thorough description, and when the care that is taken is known, it is not to be wondered at that the Leitz objectives are credited with being more uniform in quality than any others.

It has many times been stated that the reason why Continental houses produce cheaply is because they employ women workers. Leitz has no female labor at all; all his men are skilled mechanics, the majority of whom have been trained in the works.

It is quite possible for English houses to compete successfully with foreign competitors if they do but adopt their methods, which may be summarised in a few words. Have the works in a country town where rents are low, and the cost of living less than in a city. Have suitable buildings for workshops, and the rest is a matter of system and machinery.

THE QUEKETT MICROSCOPICAL CLUB.—The practical work done by this Society, which was founded in the year 1865, is recognized as being of the first importance.

The meetings are attended by the foremost microscopists of the day. The journal, which is published bi-annually, and gives reports of the papers read and the proceedings generally of the club, is always worthy of careful perusal, but the great characteristic feature of the club is the welcome it extends to the amateur microscopist and the means it affords for bringing the novice into touch with the sound principles of manipulation, working and collecting.

. On the first Friday in each month, a "Gossip" evening is held, at which specimens are exhibited by members and discussed conversationally, the regular business meetings of the society taking place on the third Friday in each month. There is, in addition, a first-rate library, and cabinet containing 6,000 slides, which are at the disposal of the members.

We have before hand a list of the excursions for the forth-coming season. These take place principally on Saturday afternoons, and have for their object the collecting of material that will afford interesting studies microscopically. "Pond life" has always been a very strong subject with the club. Visits are cordially invited to the meetings, which are held at 20 Hanover Square.

When it is stated that all these advantages are offered without entrance fee for the modest sum of 10s. per annum, it will be conceded that every microscopist ought to make a point of becoming a member, and so supporting, in a practical manner, a club which has in the past and will continue in the future to promote the best interests of every feature in microscopy.

RINGING SLIDES.—Many amateurs prepare and mount specimens remarkably well, but few manage to put the ring of cement on neatly. It requires practice certainly, but generally it is through using the cement in too thick a condition. Professional mounters have two bottles, one containing the cement, the other the solvent—generally turpentine or methylated spirits. The brush is first dipped in the solvent, then in the cement, and a thin coat is deposited on the slide as it is rotated on the turntable. Some build the ring up at once, others allow the first layer to dry and then complete the process: if there is sufficient time available the latter is the better way, but each time a fresh brushful of cement is taken, it should be preceded by a dip in the solvent. The cement can then be deposited with cleanness and regularity.—*Knowledge*.

BIOLOGICAL NOTES.

L. H. PAMMEL.

STUDIES IN CYPERACEÆ.—Mr. Theo. Holm, well-known for his studies in vegetable anatomy, has issued another paper upon the above topic. Before taking up the anatomy of *Vignæ* (*astrostachyæ*) he discusses briefly some of the main facts brought out in his studies of other species in which the following important facts are brought out with reference to the Utriculus. "If it were not that this organ possesses such excellent morphological characters, by which our species of *Astrostachyæ* may be readily distinguished from each other, one would naturally suppose that the number of the species were much smaller, by examining the anatomical structure. The fact is, when we examine the structure of utricle, we do not find any points of importance by which these species may be distinguished anatomically. The differences are so slight and seem merely to depend upon a relative broader or narrower mesophyll and a larger or smaller number of isolated stereome-bundles, that none of these may be considered as being neither constant nor of sufficient importance to be used as anatomical characters. When we finally compare the morphological and anatomical characters with each other, it seems as if our species may be naturally classified as representing a section of *Vignæ*. The transition from the "hebetatæ" to the "centrales" seems very gradual and as we have shown in the preceding, none of these species possess characters that stand as isolated among the others, either in morphological or anatomical respects. The drawings, as usual, are excellent. (Am. Jour. Sci. 11: 205, 1901.)

THE HAUSTORIA OF VARIOUS ERYSIPHÆÆ.—G. Smith discusses the anatomical and structural characters of the Haustoria with several species of this family. The haustorium contains a nucleus? The nucleus of the host plant

is more or less disorganized, the outer wall of epidermal cells becomes thickened and forms a centripetal ingrowing membraneous body, which the pedicel of the haustoria must push inward. After this growth into the cavity of the cell, the haustoria is surrounded by a sheath which consists of the plasma membrane of the host plant, and unchanged cellulose. (Bot. Gaz. 29: 153.)

CENTROSOMES.—The subject of centrosomes finds a further exemplification and confirmation by S. Yamanouchi. He was unable to find the centrosomes in the resting nuclei of the pollen mother cells of *Lilium longiflorum* but it was possible to find them in the first stages of the division of the cell. He frequently found the centrosomes either on one or both poles. The material was fixed with Flemming's solution, washed with water, 70 per cent of absolute alcohol and chloroform, and imbedded in paraffine. Materials were stained with Bohmer's Hæmatoxylin and Flemming's orange method. (Beihefte Bot. Centralblatt, 10: 301. 1 pl.)

ARE THERE BACTERIAL DISEASES OF PLANTS ?—Dr. Erwin F. Smith has just distributed separates of his four papers on the above topic published in the Centralblatt f. Bakt. Parasit. u. Infekt. The papers are of unusual excellence, showing the normal pathological conditions of the plants affected by various organisms, the figures being made from photographs. Dr. Smith discusses the evidences pro and con of the various diseases investigated by himself with some of the collateral work carried on by other investigators. Dr. Smith is well-known for his careful investigations along the line of pathology and his many experiments leave no question of the diseases discussed by him being caused by micro-organisms. It is strange that so noted an authority as Fischer should doubt that there are any bacterial diseases of plants when these facts are well recognized by most plant pathologists.

ACTION OF HYDROCYANIC ACID ON SEEDS.—Mr. C. O. Townsend in a paper on the effect of hydrocyanic acid gas upon grains and other seeds, concludes that dry seeds may be fumigated with the usual strength of the gas for the length of time required for the infection of animal life, without in any way interfering with the germ power of the seed. Dry seed may be subjected for several months to the influence of hydrocyanic acid gas at the rate of a gram or less of KCN per cubic foot without entirely destroying the ability of the seed to germinate. Seeds soaked twenty-four hours or more will not germinate in a gas stronger than 0.003 gm. of potassium cyanide per cubic foot. Seeds soaked thirty-six hours will germinate more readily than when soaked only twenty-four hours, but will not germinate in a stronger atmosphere of hydrocyanic gas than 0.0003 gm. of potassium cyanide per cubic foot. (Bot. Gaz. 31 : 241.)—L. H. PAMMEL.

Notes on Microscopy.

F. SHILLINGTON SCALES, F.R.M.S.

INSTANTANEOUS PHOTOMICROGRAPHY.—Mr. A. C. Scott, has devised an arrangement by which he has been able to obtain instantaneous photographs of microscopic living organisms. A powerful light is, of course, necessary, and in his own work he has used an arc light of 2,200 volts, giving about 4,000 candle-power. This light is placed at a distance slightly greater than the focal length of the condensing lens to obviate such concentration of heat as would be detrimental to the microscope objective. The camera is of the usual vertical type, but the important essential is a combined shutter and view-tube, which is clamped by means of three thumb-screws to the draw-tube of the microscope; this apparatus is fastened above the ocular, and after the latter has been inserted in the draw-tube. The mechanism of this apparatus is describ-

ed as follows: "Upon a movable brass plate inside a light-tight box is a 99° prism, mounted in such a way that all the light which passes through the microscope is projected upon a piece of ground glass at the end of a cone, which may be lengthened or shortened in order to give correct focus to the object, when it is properly focussed upon the ground glass of the camera directly above the microscope. Next to the prism is a hole in the brass plate for allowing light to pass from the microscope directly to the photographic plate, when the prism is moved by a spring and pneumatic release, and finally a sufficient area of the brass plate to cover the opening when exposure has been made. To take a photograph, the microscopic animal is placed in a drop of water upon a suitable glass plate, the light is turned on and the shutter so set that the object may be focussed upon the ground glass of the cone. The plate-holder is inserted and the dark slide drawn, leaving the plate exposed inside the camera bellows. The movements of the animals are easily seen upon the ground glass, and when the desired position is obtained the shutter is released, the prism moves out of the way and the light passes to the plate." The apparatus is not yet perfected to its inventor's complete satisfaction but he states that exposures as short as one fortieth of a second have been very satisfactory, and considers that thoroughly satisfactory negatives can be obtained with low-power objectives in one-hundredth of a second. The magnification has, however, ranged up to 200 diameters. Mr. Charles Baker, of High Holborn, in his last catalogue, mentions a somewhat similar arrangement for instantaneous photomicrography in which a pneumatic shutter with a prism attachment enables the object to be viewed on a ground-glass screen at right angles to the optic axis up to the moment of exposure. Mr. Andrew Pringle, in his well-known book on practical photomicrography, describes a vertical camera for the same purpose,

but of different construction. This camera is fitted with a pair of "goggles" and a velvet bag for the head. An instantaneous shutter, made of thin sheet aluminium, lies almost in the plane of the sensitive plate and bears white discs upon which the focussing is done, and the image is watched until the time for exposure.—*Sci. Gossip*.

MICROSCOPICAL MANIPULATION.

BLEACHING BONE.—Place articles in a glass vessel with oil of turpentine, expose to sun for three or four days, a little longer in the shade. Turpentine acts as oxidizing agent, forms acid liquor, which sinks to bottom of vessel, and strongly attacks bones if allowed to touch it. To prevent this they should rest upon strips of zinc, so as to be a fraction of an inch above bottom of vessel. It also applies to ivory and woods of various kinds. Prepare solution of fresh chloride lime 1, water 4. Put bones in this and allow to remain for a few days. Then take out, wash, and dry in open air. Place in mixture of unslaked lime, bran and water, boil until free from fatty substances, and are white. Pour oil of turpentine over them in tin box, which can be hermetically closed, let remain for ten hours, remove, and boil for three hours in soft-soap water. Skim off impurities, cool hot water with cold, dry bones on pine boards in open air, protected from the sun.—*Eng. Mech.*

COLORING MATTER OF ALGÆ.—R. Kolkwitz (Chem. Centralblatt), says the color of the cyanophyceæ, which are so abundant in the effluent of sugar works, and are met with both in fresh and salt water, is due to the presence in the plants of a fine indigo-blue water-soluble coloring matter, phykocyanin, as well as chlorophyll. It may be obtained in a crystalline state by treatment with ammonium sulphate, in the same manner as albuminoids may be precipitated. It is improbable that this body exercises any toxic effect upon fish; the harm caused to them he

attributed to the presence of putrid algæ in the water.

BACTERIOLOGY.

WIDAL'S REACTION IN TYPHOID FEVER.—The typhoid culture must be in a suitable condition; this is best effected by making the stock culture on agar agar, and keeping it at 37 deg. C.; and this must be renewed once a month. When the test is to be applied, a loopful of the culture on the agar is planted in a tube of sterilized bouillon and placed in the incubator for eighteen hours. At the end of that time a drop is examined under the microscope, to see whether the bacilli are active and that no clumping is present.

The serum should be carefully diluted at least one in twenty before the culture is brought into contact with it. If the reaction is obtained with serum of this strength you may be sure that ninety-nine times out of a hundred the serum has been obtained from a patient who has been attacked with enteric fever. The 1 per cent is allowed for errors in technique, and also because it has been reported

at serum obtained from cases of abdominal typhus has given the reaction. It is a question whether these causes are not a mixed infection of typhoid bacilli, with some other organisms.

BACTERIOLOGY.—Dr. W. C. Mitchell is professor of microscopy in Denver Medical College. The laboratory work consists in the use of culture media and staining reagents; cultivation and staining of pathogenic organisms; clinical methods of detecting tubercle bacilli in sputum, urine, etc.; method of detecting the bacillus of diphtheria; bacteriological examination of water, ice, milk, etc.

PRESERVATION OF EGGS.—Dr. N. Hanika (Landwirth, Woch. f. Bayern) says that he has found in the pores of even newly-laid eggs, micro-organisms which cause decomposition; and that it is evident from this that meth-

ods of preservation which aim only at the exclusion of the atmosphere must consequently be useless. He proposes in place of the various processes now in use the following novel one which he says attains the desired end completely. The eggs to be preserved, which should be as fresh as possible, must be examined closely, by tapping and otherwise, to guard against cracks or breaks in the shell. They are then laid in water of about 95° F. for about fifteen minutes, or until they are well warmed throughout. Every particle of dirt should be removed from the shells by wiping with a sponge wet with warm water. The eggs are then put, in suitable quantities, in a sieve, net, or loosely woven basket, held for five seconds in boiling water and removed thence as quickly as possible, into cold water. The eggs, still wet, are laid on a clean linen cloth and let dry off spontaneously by exposure to the atmosphere. Under no circumstances should they be dried off with a cloth or towel. As soon as they are quite dry they are packed in a box with either ground peat, sifted wood ashes, wheat chaff, wood-wool, or wheat bran, the packing material to be made thoroughly dry by heating before using. The five-second dip in boiling water was sufficient not merely to kill the microbes in the shell substance and between it and the inner skin, but to cause the coagulation of a thin but all-sufficient layer of albumin lying next the skin, and thus form an impassable barrier to the exit of water and entrance of air, with its microbes.

MICROSCOPIC INSPECTION OF PORK.—The number of carcasses examined in 1900 was 999,554, resulting in the following classification: Class A, free from all appearance of trichinæ, 968,405, or 96.88 per cent; Class B, containing trichina-like bodies or disintegrating trichinæ, 11,701, or 1.17 per cent; Class C, containing living trichinæ, 19,448, or 1.95 per cent. The number of certificates issued for 253,333 inspected packages was 12,107; covering a weight of 55,809,626, pounds. There was a great falling

off in the trade in microscopically inspected pork products. The cost of this work was \$154,950.22; average per carcass, 15.5 cents; per pound exported, 0.277 cent. For 1899 the cost was \$198,355.14.

INTERNATIONAL ASSOCIATION OF BOTANISTES.

Several leading botanists of different countries being convinced, that a better organization would contribute in a most desirable manner to the mutual aim viz. the progress of botany, have the honor to invite you to become a member of a new Society to be called the *International Botanical Association*. A general meeting will take place at Geneva (Switzerland), on the 7th of August next in the botanical laboratory of the University at 10 a. m. During this meeting several questions will be submitted to the judgement of the members and you are invited to propose orally or in writing such measures as you think it desirable that the new Society should adopt. The chief object of the Association will be the foundation of a bibliographic periodical criticising in a perfectly impartial manner all botanical publications. The criticisms will—at the desire of the contributors be published in English French or German. All will be submitted to the judgement of an editor nominated by the Association and responsible to it.

It is most desirable that the membership be as wide as possible, since this is the only way of making membership inexpensive. Under no circumstances the membership will cost more than \$6.00, including the gratis delivery of the periodical. Another great advantage of the new Society is that by its means members who live in different parts of the globe will be brought into more intimate contact one with another and this will greatly facilitate the procuring of material for investigation and demonstration. Application for membership should be sent to: Dr. I. P. Lotsy, Wageningen, Holland.

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THE use of the Microscope, both as an instrument of scientific research and as a means of affording pleasure and recreative instruction, has become so widespread, and the instrument is now so frequently found in a form capable of yielding in skilled hands good optical results, that it is eminently desirable that a treatise should be within the reach of the student and the tyro alike which would provide both with the elements and the theory and principles involved in the construction of the instrument itself, the nature of the latest appliances, and the proper conditions on which they can be employed with the best results. Beyond this it should provide an outline of the latest and best modes of preparing, examining, and mounting objects, and glance, with this purpose in view, at what is easily accessible for the requirements of the student in the entire organic and inorganic kingdoms. This need has been for many years met by this book, and the large sale of its seven preceding editions has been an extremely gratifying evidence of the industry and erudition of its author and of its usefulness as a working guide. From the beginning it opened the right path, and afforded excellent aid to the earnest amateur and careful student.

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The Viability of the Bacillus Pestis.

M. J. ROSENAU.

We now know that this organism may live for months, and even years, in a test tube, on a moist albuminous medium. And the present work shows that even when dry it may live over four months, provided the temperature is cool—less than 20° C. The bacillus of plague can in no sense be considered a tender organism, as was at first supposed. It is much easier to cultivate than the lanceolate coccus of pneumonia or the pathogenic streptococci. In this respect it resembles more closely the hardier of the hemorrhagic septicæmic group.

We tested the life history of this organism upon a great variety of objects and under various conditions. We

attempted to imitate nature. But we can not imitate all the conditions under which the organism may exist in nature, and we ought not, therefore, to apply the experience of the laboratory too literally to the life history of the plague bacillus outside of the body. We may determine with fair certainty the length of time the bacillus may live under given conditions. But these conditions are more or less arbitrary, and to a certain extent artificial. In general terms, we can state whether it is a hardy organism, resistant to influences usually detrimental to bacterial life, or one that loses its virulence and dies quickly when removed from its natural habitat. The bacillus of plague does not exist in nature on sterile glass-cover slips, nor yet in the desiccator over concentrated sulphuric acid, which were conditions used by some authors who have reported their results on this question.

The test objects were very abundantly inoculated with a pure culture of the bacillus pestis of known activity and virulence. Often the test objects were saturated. The cultures had been grown for a long time upon artificial media in the laboratory, so that their vitality was probably strongly influenced. It is a well-known fact that virulent pathogenic bacteria may at first grow very poorly upon the ordinary laboratory media, but by successive cultivation they become accustomed to the new conditions, so that they finally thrive abundantly; that is to say, they take on a sort of saprophytic existence. Such cultures would doubtless resist the various influences to which they are exposed in the laboratory tests better than another race direct from the blood or tissues. In fact, it is found that the plague bacillus in the blood and tissues from a rabbit usually dies out rather quickly when dried upon the test objects. On the contrary, bouillon cultures dried on similar objects and under similar conditions live a much longer time.

Another departure from normal conditions was the fact

that all the test objects receiving the abundant inoculations of the virulent pure cultures were sterile. In other words, not only were cultures of the bacillus used that were accustomed to a saprophytic existence, but these cultures were placed upon sterile test objects and protected against contamination, so that they were relieved from that microbial symbiosis which, in the economy of nature, plays so important a part in the suppression of pathogenic micro-organisms. It is known that in organic mixtures the hardier saprophytes tend to overpower the bacillus pestis.

PLAGUE AND FOOD.—Our experiments show that food products may harbor the infective principle of plague, but according to experience food products are not much to be feared as far as their probability of carrying the infection is concerned. This latter statement does not apply to milk and its products, for milk is a good culture medium for the bacillus pestis; and we kept it alive seventeen days in cheese and seventy-two days in butter. On the surface of food products it usually died very quickly. It did not live twenty-four hours on orange peel. We had similar results with figs and raisins and a large quantity of Chinese food products, such as smoked and dried ducks, dried oysters, dried cuttle fish, dried ducks' gizzards, ducks' gizzards dried and placed in oil, smoked and dried pork, and duck eggs preserved in a mixture of mud and rice chaff, all of which were infected with the bacillus pestis and kept at 37° C. In rice we found it alive eighteen days after inoculating.

These results correspond with all our other experiments, which plainly prove that the bacillus cannot live long on the surface of objects, when dry, at temperatures above 30° C. In one case we kept it alive one hundred and sixteen days, and in another ninety-six days, in water preserved at low temperatures, 17° to 19° C. Under the same conditions the organism lived only six days at 37° C.

TEMPERATURE.—The effect of temperature upon the bacillus pestis is very remarkable. It may be kept alive and virulent a very long time in the cold, even though dry, but it cannot live long when dry at the temperature of the body. High temperatures, such as 70° C. or more, are invariably fatal in a few minutes. It was this that led some of the early workers to conclude that they were dealing with a frail organism. It is frail when dried at 37° C., but may live for months in the cold. We have never been able to keep it alive more than a few days when dry at 37° C.—three days in flannel, two days in sponge. On the contrary we had little difficulty in keeping it alive on a variety of objects three and four months at 17° to 19° C. The bacillus is not as sensitive to temperature when kept moist, for under such conditions it will live a very long time in albuminous media at 37° C. From the experimental studies with the plague bacillus we would infer that the endemic foci of plague should be in cold climates.

Moisture is a definite factor in the viability of the bacillus pestis. The organism must have moisture to grow, and it may remain alive and virulent a very long time in the presence of moisture. It usually dies quickly when dry. However, this is not invariably the case. We have been able to keep it alive in media such as dried albumin for one hundred and twenty-five days, when it was still virulent for mice. But to keep it alive when dry the organism must be cold, i. e., exposed to a temperature less than 20° C. In no instance could the organism be kept alive when dry at a temperature of 37° C. for more than a few days. ●

Our experiments confirm those of other workers in this field, who find that for the most part the bacillus pestis soon dies when exposed to bright sunlight. Our work leads us to the conclusion that the heat as well as the sunlight plays an important role; also that the effects of the

sunlight do not penetrate very deeply. It is therefore safe to say that objects may be efficiently disinfected on the surface by exposing them all day to a bright sun, provided the temperature in the sun is above 30° C. The plague bacillus was kept alive a long time in moist garden earth, especially when kept cool. It dies very quickly in dry earth. We were not able to keep it alive longer than twenty-four hours at any temperature in dry earth. As moist earth will preserve the life of the bacillus it is easy to understand how the infection may live in dirty dwellings. It requires no stretch of the imagination to understand how the infection may be conveyed by the dirt and dust of moist, sunless habitations.

We have not succeeded in keeping plague alive very long when dried upon the surface of objects ; even on plush, carpet, paper, wood, sawdust, bone, etc., it usually dies within a few days. In porous substances such as sponge we found it alive after one hundred and twenty-five days, when allowed to dry, at 19° C. Here again temperature plays an important role, for at 37° C., all the other conditions being the same, it lived only two days.

A bacillus of plague lives long in albuminous matter. Clothing and bedding are especially apt to be contaminated with the discharges from buboes and blisters, sputum, etc. Articles so infected and kept in a cool, moist place could retain the active infective principle a very long time. Clothing and bedding may harbor the bacillus of plague for months. In one instance we kept it alive on a piece of crash ninety-seven days ; in albumin gelatine balls one hundred and twenty-five days ; in sponge, also, one hundred and twenty-five days ; in wool fifty-two days.

According to our results the plague bacillus cannot live long in letter mail. In seven tests made with cultures of the organism on paper we found that it usually died within twenty-four hours. At most it kept alive eight days

on paper allowed to dry, and fourteen days on paper kept in a moist atmosphere. To live this long it must be kept cool, for, just as in all our other experiments, it died very quickly when dried at the body temperature. We had similar experiences with plague blood upon paper.

The bacillus pestis often loses its virulence before it dies. In many of our experiments we found that the time came when the organism grew in bouillon, but lost its pathogenity for animals. This is an important fact from an epidemiologic standpoint, for an attenuated plague bacillus is probably harmless to man, even though its virulence be increased by artificial means in the laboratory.

The experiments conducted in this laboratory plainly prove that either sulphur dioxide, when moist, or formaldehyde will kill the bacillus pestis when applied in the strength and methods usually employed for these gases as disinfecting agents. In order to be effective there must be directed contact between the gas and the germ. In other words, these gaseous disinfectants can only be depended upon as surface disinfectants.

As far as practical disinfection for plague is concerned, it may be mentioned here that sulphur dioxide is probably a much more useful agent for use of ships, stores, houses, and dwellings infested with vermin, because it is destructive to the higher forms of animal life, whereas formaldehyde fails to kill mammals and insects with the same certainty that it kills microbes. In combating plague it is very important to kill fleas, rats, mice, and other forms of animal life capable of carrying the infection. Sulphur has this power, which formaldehyde totally lacks. A great number of tables exhibit details of experiments which cannot be reported here.

CONCLUSIONS.

- 1 The bacillus pestis is not a frail organism. It resembles the hemorrhagic septicæmic group or the coccobacilli as far as its viability is concerned.

2 Temperature is the most important factor in the viability of the plague bacillus. It keeps alive in the cold, under 19° C., a very long time. It dies quickly, especially when dried, at the body temperature, 37° C.

3 Moisture favors the life of the bacillus pestis. It usually dies in a few days when dry, even in the presence of albuminous matter, provided the temperature is above 30° C. It may keep alive and virulent when dry for months in the cold, under 19° C.

4 Sunlight kills the organism within a few hours, provided the sun shines directly upon the organism and the temperature in the sun is over 30° C. The effect of sunlight is not very penetrating.

5 The virulence of the bacillus pestis is often lost before its vegetability.

6 It is unlikely that new dry merchandise would carry the infection. The organism usually dies in a few days on the surface of objects such as wood, sawdust, bone, etc.

7 Clothing and bedding can harbor the infection for a long time and may act as fomites. The bacillus lives for months when dry in albuminous media at temperatures under 20° C.

8 Food products may carry the infection of plague. The bacillus lives a long time in milk, cheese, and butter. It usually dies quickly on the surface of fruits and prepared food.

9 The organism may live a long time in water, although plague is not a water-borne disease.

10 The plague bacillus does not live long on paper, and first-class mail is therefore not apt to convey the infection.

11 The colder the climate the greater the danger of conveying the infection on fomites—clothing, bedding, food, merchandise, etc.—and more extensive disinfection is required in such a climate in combating the disease than in tropical regions.

12 The plague bacillus is destroyed by sulphur fumigation and by formaldehyde gas in the strengths in which these disinfectants are usually employed. The gases can only be depended upon as surface disinfectants. In disinfecting ships, warehouses, dwellings, and other places infested with rats, fleas, and vermin, sulphur is better than formaldehyde, because formaldehyde gas fails to kill the higher forms of animal life.

13 A temperature of 70° C. continued a short time is invariably fatal for the plague bacillus. The ordinary antiseptics are all efficacious in their usual strength for non-spore-bearing organisms. Efficient surface disinfection may be accomplished by exposing objects all day to the direct sunshine on warm days. The temperature in the sun must be above 30° C.

Work on Ciliate Infusoria.

In a recent bulletin of the California Academy of Sciences, N. M. Stevens has described two new Infusorial forms. During his studies he worked on them microscopically and writes, in part, as follows :

Technique.—The respiratory tree was removed from the living holothurian, plunged into the fixing fluid, and later washed, and hardened in alcohol. Small pieces were imbedded in paraffine in the usual way, and sections 5 to 7 microns thick were cut and mounted in series. For *in toto* preparations, portions of the respiratory tree were stained, washed, and run into glycerine or through alcohols, followed by clove oil, teased upon the slide to free the infusoria from the respiratory membrane, and mounted in glycerine, glycerine jelly, or balsam.

A large number of fixing agents were tried : picro-acetic, picro-sublimate-acetic, Gilson's fluid, sublimate-acetic, iridium chloride-acetic, Flemming's strong and weak solutions, Vom Rath's solution, platinum chloride-acetic, Hermann's fluid, absolute alcohol, absolute-acetic, palla-

dium chloride, Rabl's fluid, bichromate-osmic, and osmic vapor.

Hermann's fluid gave the best results, though sublimate-acetic, absolute-acetic, Boveri's picro-acetic, Flemming's and Vom Rath's solutions proved quite satisfactory, and osmic vapor was especially valuable for temporary *in toto* preparations in the study of division stages.

Peptone and pepsin solutions, bichromate of potash (one to three per cent), formalin (one-tenth to one per cent) and fresh water were employed as macerating agents; of these, potassium bichromate (two per cent) was found to be of greatest value in revealing and isolating in internal fibre structures of *Licnophora*.

The principal stains used were Delafield's hæmatoxylin, dahlia, bismark brown, thionin, methylen blue, acid fuchsin, borax carmine, alum carmine, picro-carmine, Mayer's paracarmine, light green, safranin, Heidenhain's iron-hæmatoxylin, rubin, and ruthenium red. For fresh material picro-carmine and alum carmine gave the best results; borax carmine, paracarmine, light green, and safranin were useful in the study of fixed material *in toto*; for sections no other stain was at all comparable to Heidenhain's iron-hæmatoxylin following Hermann's fixing fluid, and used either alone or in combination with rubin or with ruthenium red.

Structure and General Biology.—*Licnophora* like most of the Ciliata has a delicate structureless pellicula not distinguishable in life, but readily separated from the cytoplasm by macerating fluids and by many fixing agents. The ectoplasm is clearly marked only at the margin of the attachment disc, between its cuticula and fibre layers, and within the triangular basal portion of the oral band where it is either homogeneous or very finely granular. The entoplasm is coarsely alveolar in both discs and more finely alveolar in the neck.

Oral Disc.—The oral disc is irregularly circular in out-

line, having a projection on the left side opposite the buccal cavity. The ventral side is depressed centrally and posteriorly, the dorsal side convex laterally and posteriorly, but continuous with the neck anteriorly. The width of the disc varies from 33.5 micron to 57 microns in fixed material, and was 72 microns in the large living specimen cited above.

The oral ciliary band begins just above the pharynx on the left side, curves about the posterior extremity and right side, and passes with a twist under the upper lip of the mouth, where it broadens out and covers the roof of the pharynx into which its cilia descend. The band is made up of about one hundred and twenty-five transverse rows of fine long cilia which are usually twisted together in action so as to appear under low power as so many stout membranellæ, but under Abbé homogeneous apochromatic oil immersion 1.5 mm., oc. 8, the individual cilia are plainly seen in the living specimen, hundreds of them in each row forming a flat brush or a stout twist. The transverse width of these flat brushes, i. e., the width of the band, is least at the beginning of the band and is increased one-half or more in the pharynx, the average width outside of the mouth being 10 microns in large living specimens. The cilia of the several rows on the left side are most often seen untwisted in the living animal at rest; while those on the right side, where the band turns toward the mouth, are often divided, one portion extending outward, the other curving toward or into the mouth.

In sections fixed in Hermann's or Flemming's fluid and stained with Heidenhain's iron-hæmatoxylin, the oral band is seen to have a complicated internal structure. At the base of each row of cilia is a deeply stained basal band whose ends are connected by fine fibres with an internal, deeply staining fibre. A cross-section of the band presents a triangular appearance with deeply stained basal

band and lateral fibres enclosing a dense homogeneous or finely granular portion. The proportions of the triangle vary greatly from the beginning of the band to its end in the pharynx.

Tracing these fibres back from the mouth-region around the peristome into the neck, their origin is found in a stout, longitudinally striated, deeply staining fibre, which arises from a branching base at the center of the attachment disc and extends diagonally through the neck to the beginning of the oral band, where it gives off a branch to each end of each basal band. The first branches given off are coarse and oblique, the later ones fine and nearly perpendicular to the basal fibre.

This stout neck fibre with its oral prolongation and branches is somewhat anisotropic, fibrous, and contractile. The only clearly differentiating stain found for it is iron-hæmatoxlin; second to this was Mayer's picro-carmin, the material being left in the stain for forty-eight hours. In macerations, the fibre with its various branches is the most resistant part of the body. Potassium bichromate (one to three per cent) will in a few seconds, aided by slight tapping on the cover-glass, dissolve away the alveolar entoplasm and the pellicula, leaving the inner layers of the attachment disc with cilia, the neck fibres and the oral band with cilia, the skeleton of the animal. Similar results were attained with pepsin and peptone solutions, one-tenth per cent formalin, and even with fresh water. The neck fibre is faintly visible in life, and is plainly seen in any macerating or fixing fluid before the cilia of the attachment disc and pharynx cease to vibrate. These facts clearly demonstrate that the fibre and its divisions so plainly shown in iron-hæmatoxylin stained sections are not artifacts.

PERSONAL.—E. G. Eberle of Dallas, Texas, is President of the Texas State Pharmaceutical Association for 1902.

The Preparation of Crystals as Microscopic Objects.

S. E. DOWDY.

Few microscopic objects are more beautiful and instructive than the crystals of various chemicals, prepared in such a way as to be suitable for viewing under the microscope. Most chemists possess a microscope, often a relic of student days, in which owing to a dearth of fresh slides, they take no further interest. The obvious remedy for this state of affairs is either to purchase more objects or to prepare some on one's own account. Where possible, the latter is much the better course to adopt, as good home-made slides are far cheaper, more typical, and instructive than bought ones. These few notes will, I trust, serve as a rough guide to the *modus operandi* to be observed in preparing this class of objects. The materials are to hand in every pharmacy, the other items required to ensure success, viz., knowledge of the solubilities of the various chemicals under trial and a certain amount of patience, should also be to hand. The other essential requisites are a few thin 3 by 1 inch clear glass slips, some medium thickness round cover glasses, a small quantity of Canada balsam dissolved in xylol, test-tubes, spirit lamp, glass stirring rod, and a small pipette.

Before starting work it is necessary to get the slips and cover-glasses perfectly clean and free from grease. That can be easily done by washing them with ammonia, rinsing with distilled water, drying them on a clean cotton rag, and finally polishing them on a piece of chamois leather. When these are ready, one of the three following methods can be adopted to prepare the slide. The first consists of evaporating down a saturated solution of the salt until enough moisture has been driven off to enable the crystals to rapidly form on cooling. The practical application of the process is as follows: Make a saturated solution of the salt in distilled water and deposit

a drop with the pipette in the centre of a 3 by 1 inch slip; slope the slide to make the liquid spread in a film, then absorb the superfluous moisture from the side of the slip with blotting paper. Now hold the slide wet side up over the flame of a Bunsen or spirit lamp, at such a distance that the liquid just steams. Continue this until you see a thin film of the salt form at the edges, then withdraw, allow to cool, and examine under the microscope. If satisfactory, the crystals can then be permanently mounted by depositing a drop of the cold xylol balsam over the film and covering with a clean cover-glass.

When the salt is insoluble in water, any suitable solvent such as alcohol, chloroform, etc., may be employed; in this case, of course, evaporation will take place rapidly without the aid of heat. Crystals formed from such solutions will probably require a different mounting medium, such as castor oil, or one in which they are not soluble. A method recommended by Dr. Lankester is to dissolve a little gelatin or gum acacia in distilled water and to add to this a few drops of a saturated aqueous solution of the salt. A drop of the warm mixture is then deposited on a slip, superfluous moisture drained off, and the slide is put on one side to cool. With some salts—copper sulphate, iron sulphate, etc.—remarkably beautiful crystalline forms make their appearance, frequently in the form of flowers and fern-like branches. Epsom salts, chlorate of potash, bichromate of potash, and, in fact, any salt soluble in water will lend itself for preparation by the above process.

The second principal method is by fusion. Its application is necessarily more restricted than the foregoing, but by its means some very effective slides may be prepared. The process is equally simple, but the results attained will not be so uniformly successful. A good substance to experiment with is salicine. Place a small quantity on the centre of a thin slip and heat it over a flame until it just

fuses, withdraw it from the heat before it chars, and allow it to cool gradually. If successful, small circular plates or rosettes will appear on the film, and these may be mounted in the usual way in cold xylol balsam. A good slide of this description, viewed with dark ground illumination, or by polarised light, will fully repay any trouble involved in preparing it. This method is useful in enabling one to prepare totally different physical forms from the same salt. With salicine, for instance, an aqueous solution deposits needle-shaped crystals, quite distinct from the circular form obtained by fusion. A point to be observed in using the process is to avoid having too much of the salt on the slip, as on cooling, the film, if too thick, will probably star and crack. If the film should be too thick for viewing as a transparent object, it will often make a good opaque one by pasting a circle of black paper on the under side of the slide.

Another class of objects, prepared in a similar way, are crystals of fatty substances, spermaceti, hard paraffin, etc. It is only necessary to place a small piece on a slip and warm it. When melted press down on it a cover-glass, the crystal forming as the mass cools. These slides cannot compare from an artistic point of view with those obtained from salts, but are interesting from the fact that the actual formation of the crystals can be watched under the microscope any number of times by simply warming the slide before viewing it.

The third principal method is still more limited in application, being confined to those substances which are easily volatilized and crystalize on cooling. Preparation of slides by sublimation may be carried out as follows. Take a dry narrow test-tube and place in it any suitable chemical—benzoic acid, for instance. Hold the tube over the flame until the acid volatilizes, now invert the tube and stand it on a cold 3x1 in. slip. The characteristic crystals will form on the part of the slip covered by the

tube, and, if satisfactory, can be mounted in the usual way. Camphor, arsenic, and many others will suggest themselves as suitable for preparing slides in this way.

The three methods described will practically cover the whole ground of preparing crystals for the microscope, and with the expenditure of a little time and patience will enable anyone to materially increase, at a nominal cost, his collection of slides. If mounted in a suitable medium, and preserved from undue heat and light, these slides will be permanent; any change which may take place in the forms of the crystals may be put down to the solvent action on them of an unsuitable medium.—*Pharmaceutical Journal*.

Notes on Microscopy.

F. SHILLINGTON SCALES, F.R.M.S.

STRIDULATING ORGANS IN BEETLES.—C. J. Gahan in "Trans. Entom. Soc." London, 1900, pp. 433-52, comments upon Schrodte's discovery of well-developed stridulating organs in the larvæ of several genera of beetles, and on the fact that the structures are generally alike in both sexes of adults, though with some notable exceptions. He describes the stridulating organs on the head, on the prothorax and front legs, on the mesothorax and middle legs, and on the hind legs, elytra, and abdomen.

ROTATORIA OF THE UNITED STATES.—In the "U.S. Fish Commission Bulletin" for 1899, pp. 67-104, are give all species of rotifers, 246 in number, hitherto found in the United States, with special reference to those discovered by the author in the great lakes. Two species *Notops pelagicus* and *Pleurotrocha parasitica*, are described as new. As a general result of his investigation the author formulates the conclusion that the Rotatoria are practically cosmopolitan, any species occurring wherever the conditions necessary to its existence are to be found. In

stagnant swamps all over the world are likely to be found the characteristic rotifers of stagnant water, with little regard to the country ; in clear lake-water, everywhere, the characteristic limnetic Rotifera may be obtained ; in sphagnum swamps the Sphagnum or moss Rotifera. Variation in the rotifer fauna of different countries is probably due to variation in the conditions of existence in the waters of those countries, not to any difficulty in passing from one region to another. In the introduction the author gives a word of warning against the naming of species by those persons who, through want of experience or knowledge of what is known, are not in a position to differentiate new forms. Such work he describes as a positive injury to science and a nuisance to all careful scientific students. It is to be hoped that everyone wishing to describe a new species of rotifer, will learn by heart and inwardly digest this sentence. In the very next paragraph the journal refers to a contribution on this subject in the "Trans. New Zealand Inst." by Mr. F. W. Hilgen-dorf, which comes under the above strictures. The author succeeded in finding sixteen species of rotifers, twelve of which he describes as new. Half of these can at once be recognized as old acquaintances, and the other half are of no value, and scarcely to be identified as rotifers. The figures of the four plates, remarks the writer of the notice, bear about the same relation to rotifers as the wooden blocks in a child's Noah's Ark do to the animals they pretend to represent.

SCALES OF FISHES.—The scales of fishes are objects of much interest to the geologist and zoologist as well as to the microscopist, and are therefore at all times an interesting study. They are important features in classification, throwing light on the conditions of the waters inhabited by their possessors, and contribute not only to the understanding of the conditions and life of the present seas, but add their quota to the sum of our knowledge of

the former conditions of life upon the earth. The scales of fishes, unlike the scales of most reptiles, are not epidermal appendages—*i. e.*, they do not grow upon the skin, like hairs, nails, or hoofs, but are produced within the substance of the skin, and are covered throughout their extent with a layer of it. A cursory glance will show that the scales figured in books are of two kinds, those having a comb-like appearance at one end, and others without this characteristic. The former are known as “ctenoid,” and the latter as “cycloid.” In the ctenoid the comb-like end is the free end, the scalloped part being imbedded in the skin. The scales are so arranged in relation to each other that the water glides from the edge of the one on to the middle of the next. The scales overlap in the direction from head to tail of the fish. Two objects are attained. The fish swims with the least possible amount of friction, and the underlying skin is shielded from the constant maceration to which it would be subject if the water were perpetually soaking between. Unlike the armour-plated “placoid” and sheeny-coated “ganoid” fishes of the geologic seas, which still have their representatives in our modern waters, the scales here described are delicate and flexible. “Ctenoid” and “cycloid” differ in appearance; but whether comb-like or rounded the structure is very much the same. An examination will show a number of consecutive lines which correspond approximately to the shape of the scale. A little careful focussing reveals also that the scale, however thin, is thicker at the centre and thin towards the edges. In some scales the concentric lines are continuous across the furrows formed by the deep radiating lines of the upper half. In the flounder and the perch they do not meet, but are broken by a line of transparent matter which appears also to line the whole scale on its underside. The explanation seems to be that the scale grows by the addition of a new layer to its underside, slightly larger than the last,

the boundary edge of which forms the characteristic concentric line. In those scales in which the concentric lines do not cross the furrows the outer layers split as they harden, the interstices being filled with the newly formed transparent matter, and this goes on during the whole of life. The thin flat scale of the eel, which must be searched for beneath the skin, as it does not project from the surface, is a very beautiful object. At first sight, when viewed through a 1-inch objective, it appears to be of a cellular character, but careful study with a $\frac{1}{4}$ -inch and a little management of the illumination shows this appearance to be caused by isolated concretions of carbonate of lime set in a layer of the same. Similar concretions may be easily seen in several of the scales between the outer laminae and the inner transparent layer. All scales are very beautiful; some of them are still more interesting through being mounted as opaque objects. Viewed by polarised light they are of course charming.—*J. Lucas.*

Fish scales make beautiful objects, when viewed with reflected light, the scales of sole being often exhibited in this way, with the light falling on them in such a manner as to show the comb-like teeth. As transparent objects they can be examined with the spot lens or equivalent arrangement, and with polarised light either with or without a selenite plate. As opaque objects it is only necessary to clean and dry the skin; as transparent objects the skin must first be dried and then mounted in Canada balsam. The following is the classification suggested by Agassiz, though subsequently modified, as quoted in the "Micrographic Dictionary." Scales enamelled: Ganoid fishes.—Those the skin of which is regularly covered with angular thick scales, composed internally of bone and externally of enamel. Most of the species are fossil, the sturgeon and bony pike being recent. Placoid fishes.—Skin covered irregularly with large or small plates or points of enamel. Includes all the cartilaginous fishes

of Cuvier except the sturgeon. As examples may be mentioned the sharks and rays. Many are fossil. Scales not enamelled: Otenoid fishes. Scales horny or bony, serrated or spinous at the posterior margin. Contains the perch and many other existing species, but few fossil. Cycloid fishes.—Scales smooth, horny, or bony, entire at the posterior margin; as the salmon, herring, roach, and most of our edible and freshwater fishes. The majority of the fossil fishes belong to the first two orders, and most of the recent to the third and fourth.—*Science Gossip*.

A Microscopic Proof of the Food of a Prehistoric Man.

T. CHARTERS WHITE.

Several years ago a barrow was opened on the downs near Warminster in which a number of human and animal remains were found heaped over the skeleton of an infant. Together with these were numerous roughly formed flint implements, indicating the period as that of the early Stone Age, the only metal being in the form of a bronze ornament of very primitive design. Having been allowed to make an examination of some of the human jaws, I now describe the condition of one as bearing on the question of prehistoric food.

It may appear impossible to affirm with any certainty the character of the food of individuals who existed probably three thousand or four thousand years ago; but the conditions under which the remains were found place us in a position to state, without any doubt, the nature of food consumed by the individual whose lower jaw is the subject of investigation. The gentleman was perfectly ignorant of the use of a toothbrush, and probably whatever performed an analogous function in others of his surrounding circle failed in his case; for his lower teeth were almost entirely covered by that salivary calculus popularly known as "tartar."

This tartar is deposited on the teeth from the lime salts held in suspension by the saliva, and by its gradual precipitation becomes a hard concrete, not soluble in the ordinary alkaline fluids of the mouth. In it, particles of food are imprisoned by daily deposition, which may remain in the same condition for ages, especially if dry. Here, then, we have this hard, solid concrete only waiting proper treatment to disengage from its calcareous confinement any particles of food closely locked up in its mass.

The method adopted was to clear all the tartar from the lower jaw and then place it in a conical drachm measure, to decalcify it by means of a weak dilution of hydrochloric acid. This solution was afterwards washed away and the sediment examined drop by drop under the microscope, a third of an inch objective being employed in the examination.

The main body of the deposit was made up of amorphous particles, probably disintegrated meal of some kind. Interspersed were numerous granules of a siliceous nature: these were fully accounted for by the extensive grinding away of the summits of the molars, which were eroded into deep pits, and must have been productive of intense discomfort, not to say pain. The granules were found when tested by polarised light to be of two characters: some that were flinty did not answer to that test, while the others did so, and were stated by an eminent geologist to be quartzite. He explained this was probably the result of the corn having been rubbed down in a roughly made quartzite mortar, with a round pebble as a pestle.

Among the first organic remains to be noticed, was the sharply pointed tip of a small fish's tooth, following which were the oval horny cells of some species of fruit resembling those going to make up the parenchyma of apples, then husks of corn, the hairs from the outside of the

husks, a spiral vessel from vegetable tissue, and several small ruby-colored, highly refractive bodies which I could not recognise.

Scattered throughout the collection of sediment were oval bodies resembling starch corpuscles, such as may be found in potatoes, but as they did not give the characteristic black cross under polarised light, it was decided they could not be starch; further, any starch would have been reduced to the amorphous condition found in the general mass of the meal. Their true nature was afterwards made evident by finding a flat plate of cartilage about 1-30th of an inch square, from the free edges of which these oval bodies were being gradually extended, so, that by the disintegration of this substance these bodies in their isolated condition proved a puzzle. Here, then, was evidence that the particles of food locked up in this tartar could be recognised after a lapse of time such as must have occurred since the Stone Age in which they were massicated. No evidences were found indicative of the use of fire in cooking the food; it must therefore have been eaten raw.

Each drop as it was examined was covered by a circular cover-glass of $\frac{1}{8}$ th of an inch diameter and carefully put aside; but to prevent this cover-glass from shifting, a ring of gum-dammar varnish was run round each, and after a few years these preparations were examined again, when it was found the varnish had sucked in by capillary attraction, and these slides, to the number of about thirty, were irretrievably ruined.

Should I ever be so extremely fortunate as to obtain another such specimen of undoubted Stone age antiquity I should dry the deposit at once and mount it in Canada balsam.—*Science Gossip*.

PERSONAL.—Henry L. Ulrich, M. D., is professor of Microscopy and Bacteriology in the Department of Pharmacy, University of Dallas, Texas.

MICROSCOPICAL MANIPULATION.

THE DIFFERENTIATION OF HUMAN AND ANIMAL BLOOD BY THE AID OF A SPECIFIC SERUM.—E. Ziemke refers to investigations of Wasserman, Schutze and Uhlenhuth, who have shown that by injecting rabbits with human blood a change is produced in the rabbit's serum, made evident by the fact that when added to dilute human blood a turbidity is caused, which does not appear with the blood of any other animal except the monkey, and describes some further tests he has made to determine the applicability of the reaction for forensic purposes. Positive results were obtained with fresh blood, dried blood, blood stains on cloth, blood in garden soil, blood from a person poisoned with carbonic oxide, blood on steel implements, blood from the wall of a cellar, blood on wood, blood in glass, blood on paper, the blood of a three-day-old corpse and putrid blood. The stains in several instances were ten or more years old, and where possible, control tests were made on the blood of the common domestic animals. In every case except one a positive result was obtained with the human blood preparations, while the animal tests were all negative; the one failure is attributed to the fact that the stain tested, which dated back to 1883, did not yield any extractive to the soda solution in which it was soaked.—*Medical Record*.

METHOD OF DISTINGUISHING HUMAN BLOOD FROM THAT OF ANIMALS.—C. Tarchetti (Gazz. degli Osped. May 19th, 1901) describes a new procedure for this purpose: If into an animal (A) the blood of a different species (B) is injected, then after a certain time the blood of the animal (A) is found to be toxic towards blood of the species (B). Thus, by repeated injections into rabbits of human blood—10 c.cm. or four or five occasions at intervals of about a week—Uhlenhuth and Wassermann got from the blood of the rabbit a serum which exhibits hæmotoxic

powers to human blood, not only in a fresh state, but also when dried and redissolved in normal saline solution. Ape's blood was the only other one which behaved like human blood. Washermann and Schultze proceed thus: Dissolve the spot of blood to be examined in a little normal saline solution; filter; place 4 or 5 c.cm. in two small test tubes, to one of which (*a*) add 0.5 c.cm. of rabbit's blood made hæmotoxic as above; to an other (*b*) add 0.5 c.cm. of normal rabbit's blood. A third control tube (*c*) may be made with 4 or 5 c.cm. of solution of the blood of any animal save ape or man in distilled water. Place the solutions in a thermometer at 37 deg. C.; if the spot of blood be human, in an hour's time the tube (*a*) will show a turbidity or a flocculent precipitate, while (*b*) and (*c*) will be perfectly limpid. Tarchetti carried out similar experiments with human blood and that of animals, both fresh and dried, for more than two months on cloth, wool, and knife blades, and found the method reliable. The reaction occurs almost as well at the air temperature as at 37 deg. C. The solutions must be absolutely clear to begin with, and he finds distilled water better for this purpose than normal saline fluid, for it brings all the hæmoglobin out of the corpuscles. He has found that the diagnosis can be at once made with the greatest certainty in a hanging drop under the microscope; a slight uniform precipitate is at once formed, and in a few minutes is seen as islets united in a reticulate pattern much resembling the arrangement of Eberth's bacillus agglutinated by typhoid serum. The same thing is observed in filtered aqueous solutions of dried blood. It is only after a long time (twelve to twenty-four hours) that a similar appearance is seen in blood of other animals.

CEMENT TO STAND SPIRIT.—Dissolve 12 grains of gelatine (previously allowed to swell up in cold water) in 2 oz of hot water. Add to this sufficient fresh fine plaster of Paris to make up a thick cream. Apply this at once to the metal

collar and neck of bottle, and press together. The parts must be scrupulously clean and free from grease before the application of the plaster. Apply an excess of this latter, and after having pushed the parts together, wipe off the superfluity. Let it stand to set for 24 hours.

BACTERIOLOGY.

VARIABILITY OF THE TUBERCLE BACILLUS.—Carl Ramus, in the Jour. Am. Med. Assoc'n, speaking of the variability of the tubercle bacillus concludes as follows:

1. Tubercle bacilli are not so easy to demonstrate as is often believed even though present in large numbers.

2. The fuchsin solutions, like those of other dyes, cannot at all time be absolutely depended upon.

3. Tubercle bacilli from different patients, and from the same patient at different times, will not invariably stain by one method.

4. The bacilli exhibiting these varying staining properties are genuine tubercle bacilli, and not other species of acid-resisting germs.

5. The staining variations probably depended on physical and chemical changes in the bacterial substance, instituted either by antitoxic action or by the products of associated organisms, or by a combination of both.

6. In the absence of demonstrated tubercle bacilli, where physical signs of tuberculosis exist, a prompt diagnosis of that disease should be confidently made in the interest of the patient, and no valuable time be lost in waiting for typical bacilli to appear.

SPUTUM AND URINE.—Suspected cases which may be confirmed by chemical and microscopical examinations are solicited. We don't want your practice, but we want the work that you may not have facilities or apparatus for. Send sputum in a clean, wide-necked bottle (as a 1-dram morphine bottle), prepaid by express, accompanied by a two-dollar bill, and it will be examined for tubercle and

other bacilli, and a report made at once. Send the suspected urine, about four ounces, well corked, prepaid by express, accompanied with a two-dollar bill, and it will be immediately analyzed and report made. Write your name on the wrapper of each bottle. Address The Regular Medical Visitor, 224 M & J Building, St. Louis, Mo.

THREE HUNDRED POUNDS OF COW'S EXCREMENT CONSUMED DAILY.—Professor Conn, of Wesleyan University, is a discussion on the subject of dairy bacteriology, made the statement that the ordinary sediment from milk, when observed through the microscope, is found to consist of sticks, insects' legs and wings, hay, blood, and pus; in fact, almost everything possible in the way of dirt, a large part of it being excrement. It has been estimated that N. Y. City consumes, daily, 300 lbs. of cows' excrement.

ACTION OF COLD ON BACTERIA.—Bacteria possess extraordinary powers of resisting cold. Thus Pictet and Young exposed cultivations of anthrax bacilli to a temperature of -76° C. for twenty hours without destroying their vitality, and similar results were obtained by Colemann and Mickendrick, who found bacteria to be capable of developing after being exposed to temperatures of -6° to -130° C. Yet, although cold does not destroy micro-organisms, it prevents their development, so that putrefactive bacteria remain quiescent in frozen meat. There are, however, certain nonputrefactive bacteria which can develop on meat which is kept only at 0° C. instead of several degrees lower. To this cause Lafar attributes the unpleasant flavor sometimes acquired by meat which has been kept for several days in an ice-chamber. This has been confirmed by Popp, who states that in cement-lined storage chambers the walls when moist swarm with bacteria, which when grown on beef-gelatin produce a mouldy flavor, and he considers these to be the cause of the objectionable flavor occasionally developed in stored

meat. Flesh which has once been frozen is liable to decompose more rapidly than fresh meat, since bacteria can more readily penetrate the loosened intermuscular tissue.

BIOLOGICAL NOTES.

ATOMS.—The Popular Science Monthly for August opens with an article entitled "On Bodies Smaller than Atoms," by Professor J. J. Thomson, the successor of Lord Rayleigh and Maxwell in the chair of physics at Cambridge, who here describes for the first time in popular language the discoveries that have made him the leading living physicist. It seems almost incredible that he should not only have discovered but also weighed bodies smaller than atoms. Indeed most of our ideas are upset by this article. We are, for example, told that the elements are all made out of particles of the same kind, and that Franklin was right in calling electricity a fluid. There are not many outside the ranks of professional students of science who appreciate how completely ideas regarding the constitution of the world have been altered by recent discoveries in electricity. We all know that the applications of electricity have become dominant in the affairs of daily life, and a few years ago the X-rays attracted general attention. The X-rays are a mere corollary to the propositions of recent electrical research. Professor Thomson by his brilliant experiments in the Cavendish Laboratory of Cambridge University has proved that electricity is carried by minute particles much smaller than atoms and that these corpuscles, as he calls them, are split off from atoms. The atoms of the different elements are all made of the same kind of corpuscles. The minuteness of an atom may be appreciated when we learn that if the atoms in a pea became as big as a pea, the pea would be as big as the earth. It is certainly marvelous that bodies smaller than an atom can be measured.

MICRO-ORGANISMS IN COAL BEDS.—A rich source of fossil micro-organisms is the various Paleozoic flints that occur in certain coal basins and other deposits. It was from such that Brongniart described so many remarkable seeds and fruits of Carboniferous plants, chiefly from the basin of Saint-Etienne. They contain all manner of vegetable tissues, and M. Renault finds these permeated with bacteria and fungi. The silica has preserved everything with great exactness and the illustrations of microscopic organisms in this matrix are much clearer than those from the fossil combustibles. Some of these are older than the coal measures and are found in the Culm and even in the Devonian, as those of the Cypridine schists of Saalsfield, in which silicified remains of *Cordaixylon* are affected by a *Micrococcus* (*M. devonius*). At Estnost, near Autun, the roots of a *Lepidodendron* have the eggs of an insect or arthropod.—*Popular Science News*.

RED RAIN.—Captain C. J. Gray, collected a small quantity of material after a heavy fall of rain on December 28, 1896, in Melbourne, Australia. I have had the material mounted, but the quantity which I received did not contain the variety of matter that some other correspondents have noted. Observed by transmitted light, there were few characteristic particles, but with the aid a polariscope I was able to detect some small crystalline fragments of the nature of quartz, etc. It seems more than probable that the phenomenon arose in consequence of one of those heavy winds which have been known to carry dust from the Sahara as great a distance as 500 miles, and which in this case may have passed over some sandy tract in a like manner. The material has all the appearance of such dust. There are some interesting references to falls of red rain in P. H. Gosse's "*Romance of Natural History*," but none of them are of the same nature as the dust at present under consideration.

MICROSCOPICAL SOCIETIES.

QUEKETT MICROSCOPICAL CLUB.—The 388th meeting was held on Friday, June 21. Amongst the additions to the library announced was a bound copy of Mr. E. M. Nelson's collected papers on microscopy and optics, presented by the author, for which a very cordial vote of thanks was passed. Mr. T. J. Davis exhibited a new cover-glass holder he had devised mainly for use in bacteriology. Mr. John Shephard, of Victoria, gave a most interesting account of the pond-life in that colony, so far as it had been investigated, and pointed to the extreme rapidity of development after the rainy season set in. He exhibited a new *Brachionus* under the microscope, and also, preserved in tubes, large colonies of *Lacinularia striolata*, etc., *Lepidurus australis*, and other forms. Prof. Hartog described the peculiar method of feeding in the common *Daphnia*, and a successful way of staining and preserving translucent organisms like *Branchipus* in paraffin. Mr. R. T. Lewis read a further note on *Ixodes redivius*, and exhibited a stained preparation of the spermatozoa. Mr. Walter Wesché read a short paper on a new male rotifer, *Metopidia solidus*, accompanied by drawings. A preliminary paper on the "Microscopic Structure of Metals and Alloys," by Mr. Sidney Smith, was read. Votes of thanks were passed for these several communications, and the proceedings terminated. The informal meetings of the club for conversation and the exhibition of objects will be held on the first and third Fridays in July, August, and September.

NEW PUBLICATIONS.

"The Microscopy of the More Commonly Occurring Starches." By Professor Hugh Galt. (Bailliere, Tindall & Cox.) Illustrated. This is an unpretentious little vol-

ume which aims at giving the analyst, student, and others who may have to examine materials for adulteration, etc., a basis on which to work. For this purpose a number of photographs have been taken with the aid of a microscope and reproduced in the book with the magnifications in diameters exactly stated. Starch grains are peculiarly unsatisfactory subjects from a photographic standpoint, and the internal markings by which the student is usually directed do not appear conspicuously in the photographs used.

We are not sure the aqueous medium that was used for the specimens is the best mountant, and we have often found that the details of such subjects are better displayed in some media than in others. Still the basis for working and deductions are sound, the contours, and sizes of the various starches are at once apparent, and these, after all, are the principal features which must guide any comparisons or examinations. We believe that the book will be found an extremely useful one to those interested in the subject and possibly to microscopists generally, for starch grains are easily secured, and there is considerable interest attaching to their examination.

MOSESSES WITH A HAND-LENS.—Printed on excellent paper copiously illustrated (8 full-page plates and 44 figures inserted in the text), with new and artistic drawings from nature. No old text-books illustrations, complete glossary, Two easy and accurate keys, one based on habitat, the other on structure. It makes the study of mosses as easy as that of the flowering plants. Price \$1.10. "Even at this day I can vividly recall my experiences when I began the study of the mosses, with no one to go to for assistance, and no book available except Lesquereur & James' Manual. Had such a book as Mosses with a Hand-lens been then accessible, it would have saved me many disappointments, not to speak of the loss of much valuable time. I can therefore most cordially commend this

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and a review of the whole animal, vegetable, and inorganic kingdoms specially suited for microscopic purposes, must be essentially a cyclopædic work.

Although no changes of so important a character as those which distinguished the seventh edition of this book from the editions that had preceded it have been necessitated, yet a thorough and complete revision of the entire text has been made; eight chapters have been entirely reconstructed, and everything of importance to Microscopy which has transpired in the interval has been noted. This applies to the theory of the Microscope as well as to its use. Many new illustrations have been included and it has been very materially increased in size.

The editor has adopted a classification of microscopes that we hope may be of value to many in the purchase of a stand, especially as he also points out the great and successful efforts which English, Continental, and American makers have made within the last few years to supply good and useful microscopes at greatly reduced prices.

OUTLINE OF CONTENTS

Chapter

- I. Elementary Principles of Microscopical Optics
- II. The Principles and Theory of Vision with the Compound Microscope
- III. The History and Evolution of the Microscope
- IV. Accessory Apparatus
- V. Objectives, Eye-pieces, The Apertometer
- VI. Practical Microscopy; Manipulation and Preservation of the Microscope
- VII. Preparation, Mounting, and Collection of Objects
- VIII. Microscopic Forms of Vegetable Life—Thallophytes
- IX. Fungi
- X. Microscopic Structure of the Higher Cryptograms
- XI. Of the Microscopic Structure of Phanerogamic Plants
- XII. Microscopic Forms of Animal Life—Protozoa
- XIII. Animalcules—Infusoria and Rotifera
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- XV. Sponges and Zoophytes
- XVI. Echinodermata
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- XVIII. Mollusca and Brachiopoda
- XIX. Worms
- XX. Crustacea
- XXI. Insects and Arachnida
- XXII. Vertebrated Animals
- XXIII. Application of the Microscope to Geological Investigation
- XXIV. Crystallization, Polarization, Molecular Coalescence
- Appendices and Tables
- Index

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Protoplasmic Currents and Vital Force.

PROF. A. L. HERRERA, M. S. A.

I have lately stated that some currents of granules may lead to the formation of a pseudopodium in my synthetic protoplasm observed under the microscope.* What occurs, however, is an exact imitation of the natural phenomenon. The internal energy of the said currents expends itself in external movements. The fluid loaded with granulations strikes, as it were, a blow as it dashes against the endosarc, or the limiting membrane of the protoplasm, and pushes it outwards.

But these currents play a more important part ; they induce, indeed, the following processes :—

* *Natural Science*, August 1898 ; *Bull. Soc. Zool. France*, 1898, p. 119 ; *American Naturalist*, December 1898.

1st. Renovation of the surfaces of contact between the oxidisable parts and the external oxygen. More effective elimination of carbon dioxide.†

2nd. Conveyance of the nutritive particles and residues. Nutrition of the masses of alveolar protoplasm, which fulfill the functions of glands, etc., according to principles of Van't Hoff, Becquerel,‡ and Loeb. Circulation of the reserves and circulation in the zymoses.

3rd. Deposition of certain materials and separation of some others according to their solubility, density, and so forth. Concentric formations, incrustations, etc.

The study of these internal currents is, one may say, the chief aim of physiology. They may be explained in terms of known physico-chemical causes rather than by an undiscovered and undiscoverable vital force. The causes are—

A. Diffusion and osmotic currents.

B. Heat. Oxidations.

C. Ingestion of the materials that support the phenomena of diffusion and oxidation.

D. Partial vacua and changes of every kind in internal pressure, induced by evaporation, etc.

The action of these causes may be tested by both the natural and the synthetic protoplasm.

A. The use of gummy water is indispensable if one wishes to observe the circulation of protoplasm in the elements of trees, and the movements are generally dependent on the conditions of diffusion (cf. Butschli's foams).* The currents of the artificial product vary in accordance with diffusive power of the substances, the quantity of liquid, and the presence of some large granulations.

† See A. L. Herrera and D. Vergara Lope, "New Theory of Respiration." Congress at Moscow, 1898.

‡ Becquerel, "Les forces electro-capillaires dans les phenomenes de nutrition." *Comptes rendus Acad. Sci. Paris*, 16 Fevrier 1875.

* See Milne-Edwards, "Anatomie et physiologie comparee."

B. The rapidity of diffusion increases, within certain limits, with an elevation of temperature (Graham). The movements of the protoplasm increase in rapidity between 10 and 22 degrees, becoming slower beyond those limits, and stopping between 45 and 48 degrees.

I have seen that at a suitably high temperature these currents present themselves even in very viscous liquids. It is evident that oxygen as well as the liberation of heat attendant on respiration are equally necessary to every being.

C. The paralysis of artificial currents ceases completely with an addition of peptone or a new quantity of salts.

D. This is an evident principle. It is enough to remember the facts concerning the circulation of sap and blood. The paralysis of internal currents stops life everywhere, decomposition coinciding with an absolute diminution of movement.

The rapidity of the course of blood through the capillaries is identical with that of the currents of protoplasm and varies likewise according to conditions, its result being the same—nutrition and life.

A motionless peripheral layer of serum is observed similar to that apparent in the currents of pseudopodia.

The difference between latent and oscillating life lies, in short, in the almost absolute or simply partial inhibition of the internal currents. Water, heat, and oxygen are required as in a physico-chemical phenomenon, and I have often suspended the currents in my protoplasm by means of desiccation or refrigeration for months together. There is then another argument against my theory which regarded movements as a result of the discharges of carbon dioxide—a theory which has certainly been for me a source of fertile suggestion, though I have now given it up.

The importance of a large quantity of water in internal currents is perfectly demonstrated. I have shown that

dilution has a great influence on the rapidity of the granulations in my artificial protoplasm.

Now, the gray substance contains more water than the substance in the cerebellum, and this has more than the white substance of the brain and medulla (R. Dubois). The neuroplasm has doubtless its currents, and the variations exhibited in their rapidity, as well as the shocks of their molecules and the waves produced, perchance, by the passage of the current from a conductor with a big calibre to a thinner one, may result in certain nervous and continuous actions or sensations, external stimuli provoking the vibrations, as I have studied in mercury.* On the other hand, Dubois says that anæsthetics produce the expulsion of internal water, and I have observed that exhalations of ether have the property of energetically repelling any thin layers of water ("On a Property of Ether," *Memorias y Revista Sociedad Alzate*, 1895-'96, Nos. 5, 6, p. 33). This means that anæsthetics modify the rapidity of the currents or even succeed in completely preventing them.

The action of alcohol on my artificial product is curious, there being a remarkable excitation of the movements followed by their absolute paralysis.

In the sea-urchin egg says Dubois, segmentation can be prevented by hindering hydration by the addition of of salt at 2 per cent to the sea water. When segmentation has already begun, it stops in a strongly salted medium, but it pursues its course directly after some normal water is poured on it; and, what appears more notable, it then continues with increased rapidity. I have observed analogous phenomena in artificial protoplasm.

In a word, the protoplasmic currents have a constructive or formative action comparable to that wrought by rivers on the earth's surface.

* *Natural Science*, December, 1898.

Contractile vacuoles can be explained by an augmentation of tension promoted by some endosmotic currents. The former may be imitated by alternatively stretching and relaxing a plate of gluten.

Life ought not to be likened to a continuous chemical reaction, the mechanism of which remains involved in darkness and unexplained. Life is now to be defined as the result of the physico-chemical action of protoplasmic currents, the cause of such currents being diffusion, heat, and some other secondary factors. Death consists in an absolute suspension of the internal currents in general; latent life is characterised by the establishment of the said currents under the influence of oxygen, heat, and water, in a germ or organism having the structure and chemical elements necessary, and supplied with every nutriment required. Oscillating life is nothing more than an alternate contribution and reassertion of the constructive internal currents (sleep), depending upon the variations of the external temperature. Every physico-chemical or mechanical action capable of affecting the rapidity, direction, and other characters of internal currents must have more or less influence on the phenomena hitherto considered as vital.

There is a new series of proofs; the experiments of the writer on the movements and evolution of alkaline oleates in the Pfeffer's solution. (See "Memorias de la Sociedad Alzate," 1900).

Colouring of Water by Micro-Organisms.

BY JAMES BURTON.

It is well known, not alone to microscopists, that large or small bodies of water are sometimes coloured by the presence of various organisms, either animals or plants, often of microscopic size. Every roadside pond is liable to become of a thick soupy appearance and green colour

from the multiplication in it of the very common *Euglena*, or some other of the unicellular algæ, such as *Protococcus*. Frequently portions in similar localities appear pink or red, owing to the existence in them of immense numbers of some of the *Daphniæ* or water-fleas. In the two cases now to be described, the colour, though extremely marked and characteristic, was the result of the presence of less common organisms.

Early in October the ornamental water in the Botanical Gardens, Regent's Park, appeared of an almost uniform pale green. On close examination this was seen to be due to some minute bodies diffused through the water; they were not merely floating on the surface, but seemed about equally distributed at all visible depths. Every twig and thread of water-weed, etc., at the margin was covered with what looked to the unassisted eye like tiny green balls, while in the quiet corners and backwaters towards which the breeze was blowing, the same bodies were collected in such quantities as to resemble thick light-green paint. Under the microscope it was found that the tiny balls were of irregular outline, and consisted of small algæ in colonies of various sizes, formed of more or less spherical groups. These were made up of very numerous individuals, oval or pear-shaped, so minute that the green colour noticeable in the aggregations was not distinguishable in them. The groups were hollow and surrounded by a thin layer of jelly or mucilage. In many cases there seemed to be spines radiating from the individuals, but these have no real existence, and the appearance is probably due to the mucilage composed of the swollen outer cell-walls of the separate members not having yet entirely coalesced.

The colonies, I think, have no motion within themselves, but, being of nearly the same specific gravity as the water, are very readily moved about by any slight current, such as would be set up by wind, or by the sun

shineing on the surface and causing a difference of temperature between different layers. Owing to the disengagement of gas under the influence of light, there is a tendency in the organisms to rise to the surface, while the gelatinous envelopes make them cling to one another and to any object with which they come in contact. Thus are larger and more noticeable masses formed, which, however, have very little cohesion, and disperse again readily. My somewhat doubtful identification of *Coelosphaerium kutzingianum* is approved by an authority who kindly took the trouble to examine specimens. A figure is given in Dr. Cooke's "Introduction to Freshwater Algae," and the size of the individual cells is stated to be 2 to 5 microns, and that of the families 60 microns. The alga is probably not rare; but as it was not recognized by two or three microscopists to whom it was shown, it is most likely seldom noticed, and certainly does not commonly occur in such numbers as to give any tint to the water it inhabits.

Attempts to mount these algæ in several preparations of glycerine were not successful, the groups breaking up. Chlor-zinc-iodine (Schulze's solution) gave better results. So did some other fluid media; but the distinctive characteristics are hardly likely to be enduring.

A somewhat more remarkable instance, both as to the color and its cause, came under notice in January, 1898, in a farm pond at Hampstead. When first seen, the water appeared of a rosy-pink tint, owing to a growth which had formed on dead leaves and debris of various kinds. About a week later, however, the pond presented a striking aspect. When some distance from it, the water seemed to be of a beautiful intense red-purple, so exactly resembling what might be reflected from the sky in a fine winter sunset that I involuntarily turned round as I approached, almost expecting to see the sun setting behind. On closer examination it was seen that every leaf and

twig at the bottom was of this brilliant tint. Some floating patches of *Confervæ* looked like masses of vivid purple, without a particle of their normal green being visible. The organisms producing this effect were spread in a thin layer over everything, and also formed delicate filaments lightly attached, which, however, were dissipated by the slightest movement. On agitating the *Confervæ* or leaves, the color-containing matter was at once diffused through the water.

Under the microscope it was found to consist of exceedingly minute bodies, so small that a very definite outline could scarcely be made out with a power of 500 diameters. These were surrounded by a thin layer of mucilage, and mostly aggregated into hollow spheres; many were solitary, but some were gathered in masses. The filaments it was almost impossible to examine in their original form, but they were composed of the same minute bodies disposed more or less in line. A friend kindly brought the matter under the notice of a professor of botany, who at once identified the organism as a bacterium now named *Beggiatoa roseo-persicina*. He referred me to the paper by Dr. Lankester, published in "The Quarterly Journal of Microscopical Science" for 1873, N. S., vol. xiii. Dr. Lankester there describes, under the name of *Bacterium rubescens*, an organism he discovered in some jars containing putrescent remains of animals and plants which had been undisturbed for a short time. The point to which he pays most attention is the remarkable color of the "plastids," which he considered characteristic of the species. There is little doubt that it is the same species mentioned by Dr. Cooke in his "British Freshwater Algæ" as *Pleurococcus rosco-persicinus* Rabh., with the remark that it is "certainly not a good pleurococcus." He gives the size of the individual cells .0015 to .004 m. It is not mentioned in the same author's "Introduction to Freshwater Algæ." I

do not see the reason for classing this bacterium with *Beggiatoa*, as to me it seems it would be more correctly considered as a *Micrococcus*.

Apart from the color, the most interesting fact about these lower forms of life is that, while ordinarily present to a small extent, occasionally, owing to favorable conditions of environment and food supply, they multiply so enormously as to have the effect described. Thus giving a visible example of what must occur invisibly during epidemics of diseases, such as influenza and plague, which, according to modern science, are caused by micro-organisms distantly related to them.—*Science-Gossip*.

The Blood in Health and Disease.

For anything approaching accurate microscopic blood work it is necessary to have at least a 1-12 inch oil immersion objective with a one inch eye-piece. This combination will magnify about 1000 diameters. Such a power will enable one to study the various kinds of corpuscles and their pathological variations; and will reveal as well the malaria plasmodium and all the smaller bacteria.

Blood specimens are sometimes examined fresh, that is shortly after the blood is drawn and before it has dried; and, secondly, specimens are prepared by drying, fixing, and staining—a process which serves to bring out the various elements of the corpuscles in different colors.

To prepare fresh blood specimens for examination, we should clean a slide and cover slip with alcohol or ether upon a clean towel, and carefully rub dry and polish them in the towel, not touching their surfaces but catching them by the edges to handle them and laying them aside upon clean white paper.

Prick the finger or ear to draw blood, after first cleaning the part with alcohol on the towel and rubbing dry. Wipe away the first drop that appears and then just touch the cover glass to the apex of the next drop so as to obtain

a very small drop upon the glass, and finally place the slip bloody side down, upon the slide. If quickly done, the blood should spread out under the surface of the slip in a thin film. The specimen is then ready for examination. To examine, put upon the cover slip a small drop of cedar oil, place the slip upon the microscope stage, lower its objective until it touches the oil, and focus.

In examining a fresh specimen of blood, the red corpuscles are seen as highly refractive bodies, slightly yellowish perhaps, which are shown to be concave by altering the focus with the fine adjustment screw. They are all of one size in health, and are perfect disks.

The leucocytes are of irregular shapes, and of varying sizes, and contain nuclei which appear somewhat more granular than the rest of the cell body. Some of the leucocytes may be seen to slowly alter their shapes.

The irregularities in size, shape, color and general appearance of the red corpuscles, are of great pathological interest. They may be paler, when the haemoglobin is below normal, but it is difficult to decide this point without the use of a haemoglobinometer or a determination of the specific gravity of the blood. The more important questions of pathologic interest are whether there are present in the blood, red corpuscles larger or smaller than normal, or nucleated red corpuscles, or red corpuscles of irregular shapes.

Abnormally small red blood cells are called *microcytes*, abnormally larger ones are known as *macrocytes*. Thus we may speak of a condition of *microcythaemia* or of *macrocythaemia*.

Nucleated red corpuscles of ordinary size are *erythroblasts* or *normoblasts*, while such nucleated corpuscles of extraordinary size are known as *megaloblasts*, or *gigantoblasts*. The presence of megaloblasts or giant nucleated red cells is regarded as quite a serious symptom and usually forecasts a fatal issue for the case. The megal-

blasts may be from two to five times the size of the ordinary red corpuscle.

The irregularities in shape of the red corpuscles are very marked in many blood affections. The deformed cells may be kidney-shaped, anvil-shaped, flask-shaped, or of such shape as resembles no other object. The condition of the blood characterized by deformed red corpuscles and irregularities also in size is called *poikilocytosis*. Cells otherwise normal whose edges are irregular in outline with toothlike projections are known as *crenated* cell; these are often due to the drying out of the specimen or to some other outside influence.

So far as the leucocytes are concerned, they can be observed more satisfactorily when stained. The fresh unstained specimen is well suited for examination for the malarial plasmodium. The malarial parasite is a mass of clear protoplasm containing black granules which are in active motion. In an unstained specimen, if the parasite contains few granules, it may be difficult to make out.

In a fresh specimen the body of the parasite may sometimes be seen to be in motion, changing its shape, stretching out filaments and exhibiting those activities known as amoeboid movements. Simon in his "Physical Diagnosis" advises a beginner to prepare a saturated solution of methylene blue in a 6 per cent salt solution (isatonic to the blood) and to proceed as follows.

After puncturing to draw blood, wipe off the first drop and apply a very small drop of the solution over the puncture so that the next drop of blood flows out into this solution. Then just touch the cover slip to this and drop it on a slide as directed above for a fresh specimen. The blue stain serves to color the parasite and makes it more easily recognized.

Staining blood specimens is done in a number of ways, but there are two methods in general use—staining with eosin and methylene blue and the use of Ehrlich's tri-acid

stain. The latter stain is so difficult to prepare it is best to buy it already prepared and tested.

For ordinary work in examining blood the following stains and methods of work are perhaps as convenient, simple and efficient as any other. Prepare the solutions as follows:

A. A saturated alcoholic solution of methylene blue, and keep as a stock solution.

B. Stock solution A 1 cc. aqua distillat 9 cc. This is an ordinary counter stain for blood and pus, but the next solution meets almost every need, so that B may be dispensed with.

C. Loeffler's M. B. solution: Stock solution A. 30 cc. 1-10,000 solution of KOH 100 cc. This is the stain to use for the diptheria bacillus, but it is as good as any other preparation to use for a counter stain. The weak aqueous solutions of M.B. deteriorate and need to be frequently renewed.

D. Eosin 0.5 grm. 75 per cent alcohol 100 cc.

E. Ehrlich's tri-acid stain, which is purchased already prepared.

To stain with Eosin and methylene blue :

1. Clean and polish two cover glasses and a slide with alcohol and a towel.

2. Puncture to draw blood. Touch one cover slip lightly to the drop, and place it upon the other cover slip so that the blood spreads between their surfaces. After blood has spread, catch these glasses by their edges and draw them quickly and smoothly apart so that each glass shall be covered with a blood film or "smear."

3. Dry these specimens in the air or by holding them near a flame where the hand can endure the heat. If the specimen dries too slowly, crenated corpuscles are apt to result.

4. Fix the film either by heat or in some solution.

To fix by heat the simplest method is to draw the specimen three times through an alcohol flame—holding the cover slip in a spring forceps. A more accurate method is to place it on a metal plate at 110° F. for 20 minutes. To fix by alcohol, place the slip in alcohol for from a half hour to twenty-four hours. The following mixture will also give excellent results:

Forty-per-cent solution of formaldehyde m. v. Aquæ destillat. m. xlv. alcohol q. s. Immerse the specimen in this solution for five minutes. Then stain.

A. Cover the slip with the eosin solution D (it is only necessary to flood the film side of the specimen). Let it remain from one-half to one minute and wash by running water over the specimen until the water comes away clear.

B. Flood slip with methylene blue solution C. Let it remain about two minutes and wash as before.

6. Dry either as the specimen was first dried, or in clean filter paper.

7. Mount in a half drop of Canada balsam upon a slide, placing the film side down in the balsam. Examine with the oil immersion lens, dropping a half drop of cedar oil on the upper surface of the specimen.

To use Ehrlich's stain we proceed exactly as above excepting we should write:

5. Flood the slip with Ehrlich's tri-acid stain. Let it remain from three to five minutes and wash. The washing and drying should be done quickly, especially if ordinary hydrant water is used.

The first method of staining is equivalent to the use of Plehn's solution which is a mixture of eosin and methylene blue. Staining by eosin and methylene blue causes the red corpuscles to appear red, the cytoplasm of some leucocytes very faintly blue, while all of the nuclei are stained blue. The granules of the eosinophiles stain decidedly red, and the nuclei are a pale blue.

Staining with Ehrlich's tri-acid stain causes the red corpuscles to appear a pale orange color, the neuclei are pale blue, the eosinophile granules are dark red, the neutrophile granules are also red but are distinguished by being smaller than the eosinophile granules.

In both of these methods, the malarial parasite appears as a pale blue body with black granules. These methods if carefully carried out, will meet almost every ordinary need of blood staining.—*Medicus*.

The Microscope and its Revelations.

Review from "Knowledge."

Eighth Edition. (Carpenter.) Edited by the Rev. W. H. Dallinger, D.SC., D. C. L., LL.D., F. R. S., etc. 817 illustrations in the text, 23 plates, 1136 pages. 8vo, cloth; \$8.00. (J. & A. Churchill.)

The appearance of a new edition of this standard work on the microscope and its many branches is particularly welcome, for it enables a comprehensive survey to be made of the progress that has been effected during the last few years in both the optical and mechanical departments, and indicates the pressure that modern research has brought to bear on manufacturers, causing them to do their utmost to satisfy the needs of workers. In a former edition of this work—the seventh—the editor, the Rev. W. H. Dallinger, condemned in no uncertain language, the microscope known as the Continental Model; and laid down broad but sensible lines for the building of the stand that was to meet the demands of the various workers of the future. It was in that edition also that a strong plea was urged on behalf of the condensers having large aplanatic apertures and for increased accuracy in manipulation generally. A reference to the new edition of the work shows how accurate were the author's opinions and recommendations, and they were

undoubtedly no inconsiderable factor in the general improvement that has since taken place in the design, and accuracy of action, of the best microscopes of to-day. This is revealed in the pages of the new volume, for many of the microscopes therein figured and described as types have been designed since the last edition was published, and owe their origin in some measure to the strong expressions of opinion then made. The present volume gives a clear exposition of knowledge and theory regarding the microscope; and although much of the text is to be found in the former edition, there are many new and re-written portions which add to the value and lucidity of the book. The reviews of the products of the various opticians are generous and fair, and will be found useful to those who need advice in the choice of apparatus.

It is a matter for regret that the publishers have not seen their way to issue the book in two volumes—one devoted to the microscope and its optical fittings, and the other to the various branches of research with which it is associated. Many workers would require only the first part, while the second would appeal to general readers as much as to microscopists. In its present form it is rather a bulky book, especially for those who are residents abroad or travel with their microscopes. A little error concerning cover glasses has been perpetuated in the new volume. Not only are the thicknesses given for the three grades of cover glasses less than can be regularly obtained, but the thinnest covers are universally known as No. 1, the medium as No. 2, and the thick as No. 3, whereas the reverse order is there given. Also the price of a $\frac{1}{4}$ in, .82 N. A. objective on page 374 given as \$15 should be \$7.50. The book is well printed, the illustrations carefully prepared and well displayed, and the book is one that will be found invaluable as a text book to all microscopists.

Extracts from Postal Microscopical Society's Note-books.

Edited for Science Gossip.

DEVELOPMENT OF GNAT.—My object in these slides is to illustrate the transformation of an insect. I am not able to send a slide of the eggs of the gnat, but in "Science for All" Mr. Hammond says that they are laid in small boat-shaped masses which float on the surface of the water. The eggs themselves are of an oval form with a kind of knot at one end, and are arranged side by side and closely packed together. In Duncan's "Transformation of Insects" it is thus written: "The male gnats have pretty hairy antennæ, like little feathers, and the females have antennæ which are almost plain. It is therefore not difficult to distinguish one from the other, and it is rather important, for the females are the blood-suckers. When about to lay their eggs they seek the water, and with the assistance of their long hind legs collect and agglutinate them together and place the little boat-shaped mass upon the surface of the water, and then leave it to its fate." The larvæ are soon hatched, and grow with great rapidity. They are almost always seen with their heads downwards and their tails towards the surface of the water. After the larvæ have grown to a certain size they undergo a change of skin and become nymphs or pupæ, and it may be noticed that when the nymphs come up to the surface of the water they do not present their tails like the larvæ, so as to obtain air, but allow their backs to touch the surface, just where there are two respiratory tubes. When the perfect insect is about to emerge from the nymph stage it floats on the surface of the water, perfectly at rest, and the skin of the back, which is exposed to the air, dries and splits open. Then the perfectly-formed insect begins to come out: first it protrudes its head, then a portion of its body, and after a short time one leg after the other is disengaged from

the nymph skin; after a little while it tries its wings and flies away. It will be noticed that the female gnat has no halteres.—*T. G. Jefferys.*

The best account of the gnat known to me is that given by Professor Miall in his "Natural History of Aquatic Insects," from which the following are excerpts: "Small stagnant pools and ditches are the favorite haunts of the larvæ and pupæ of the gnat. A ditch in a wood choked with fallen leaves is one of the best hunting-grounds, and in the summer months they may be found by the thousand in such places. The larva, when at rest, floats at the surface of the water. Its head, which is provided with vibratile organs suitable for sweeping minute particles into the mouth, is directed downwards, and, when examined by a lens in a good light, appears to be bordered below by a gleaming band. There are no thoracic limbs; the hind limbs, which are long and hooked in the chironomous larvæ, and reduced to a hook-bearing sucker in *Simulium*, now disappear altogether; a new and peculiar organ is developed from the eighth segment of the abdomen. This is a cylindrical respiratory syphon, traversed by two large air-holes, which are continued along the entire length of the body to supply every part with air. The larva ordinarily rests in such a position that the tip of the respiratory syphon is flush with the surface of the water, and thus suspended it feeds incessantly, breathing uninterruptedly at the same time." Professor Miall's explanation as to how it is possible for a larva heavier than water to remain floating at the surface without effort, as the larva of the gnat appears to do, is too long to give here. It deals with the surface film. "After three or four months the larvæ are ready for pupation. By this time the organs of the future fly are almost completely formed, and the pupa assumes a strange shape, very unlike that of the larva. At the head end is a great rounded mass which encloses the wings and legs of the

fly, besides the mouth parts and other organs of the head. Each appendage has its own sheath, part of the proper pupal skin, and the appendages are cemented together by some substance which is dissolved or softened by alcohol. At the tail end is a pair of flaps which form an efficient swimming fan. The body of the pupa, like that of the larva, is abundantly supplied with air-tubes, and a communication with the outer air is still maintained, though in an entirely different way. The air-tubes no longer open towards the head. Just behind the heart of the future fly is a pair of trumpets, so placed that in a position of rest the margins of the trumpets come flush with the surface of the water. Floating in this position the pupa remains so long as it is undisturbed; but if attacked by any of the predatory animals which abound in the fresh water it is able to descend by the powerful swimming movements of its tail." Then follows an explanation, too long to quote, as to why the respiratory organs are changed from the tail end in the larva to the head end in the pupa. "But a time comes when the fly has to escape from the pupa-case. The skin splits along the back of the thorax, and here the fly emerges, extricating its legs, wings, head, and abdomen from their closely-fitting envelope." "The mouth of the female gnat is provided with a case of instruments for piercing the skin and drawing blood. The foremost of these is a tube split along its hinder side, which lies in front of the rest, and is used in suction. This, though long and slender, is stouter than the delicate parts behind it, and it serves to stiffen and protect them; then come fine, long, and slender blades of great delicacy. Two pairs correspond to the mandibles and maxillæ of other insects, though here they are so simplified and attenuated that it is not easy to make out the correspondence. The maxillæ are furnished near their tips with a row of extremely minute saw-teeth. There is also a fifth unpaired imple-

ment, which is an extraordinary development of a part of the insects's mouth, which is usually quite inconspicuous. Besides these piercing implements, the gnat is provided with a soft, flexible sheath which represents the labium. This takes the shape of a tube split along its foreside, which surrounds and protects the delicate parts within. The extremity is divided into two lobes."—J. J. Wilkinson.

Quotations from Professor Miall need no further explanation. The gnat (*Culex pipiens*) would make an excellent study for microscopical beginners, perhaps even more so than the common cockroach. We may call attention in addition to the beautiful antennæ of the male gnat, and to the scales upon the wings and body, which latter can be readily removed by means of a camel-hair brush, and so transferred to a slide. The larva in particular makes a most interesting microscopical object, owing to its transparency, which enables the tracheal tubes, the digestive tube, and contractile vessel that performs the duty of the heart to be readily made out. The gnat *C. pipiens* must not be confused with the allied genus *Chironomus*, or Midges.—*Science-Gossip*.

Notes on Microscopy.

M. I. CROSS.

DRAWING WITH THE CAMERA LUCIDA.—Photo-micrography has largely displaced the use of the camera lucida for reproducing structure as seen through the microscope, but in numerous cases photo-micrography does not do justice nor reveal details in such a manner as to permit of a proper judgment being formed of the appearance of the subject; photo-micrography will only show one plane sharply at a time, and all sense of solidity, depth, etc., is lacking. When a drawing of an object is made, the perspective can be reproduced and a far better and truer idea given of the object generally, subject of course to

the delineation being accurate, than photography will permit.

Drawing with a camera lucida is an acquirement which calls for a considerable amount of practice, and is not successfully undertaken without a large amount of skill in the use of the pencil. This condition being fulfilled, very beautiful work can be and frequently is done. Probably the most generally useful and popular of all the camera lucidas is that known as Beale's neutral tint, in which a piece of tinted glass is set at an angle of 45 degrees to the eye-lens of the microscope, the upper surface reflecting the image to the eye. I have a decided preference for this pattern, although it suffers from the disadvantage of necessitating the microscope being set horizontally, and the image is reversed at the top and bottom, while the sides remain constant. Still its simplicity recommends it, and very little acquaintance with it enables one to utilize all its capacity.

For many purposes a camera lucida that works with the microscope vertically, horizontally, or placed at any angle is desirable, and for such the Abbe Camera is generally considered the best. The object is drawn as seen in the microscope, and, when working, the mirror reflects the image of the pencil point and paper on which the pencil is tracing, into the apparent field of view. I have recently been working with Ashe's Camera Lucida with the modifications described by Mr. Scourfield in the *Journal* of the Quekett Microscopical Club for 1900, and believe that for many purposes this will be found the most practical and convenient pattern of camera. It combines the ease of working of the Beale's neutral tint without the transposition of the object and has not the disadvantage of bulk possessed by the Abbe Camera. It can be used at any angle to which the body of the microscope may be inclined, from 45 degrees to the horizontal, quite comfortably, and by turning it round sideways on

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the eyepiece, it can be used at any angle from the vertical to 45 degrees. The image from the eyepiece is received upon the mirror which consists of a silvered disc of microscope cover-glass mounted on a brass plate, which can be revolved by the pin. The image is then reflected to the neutral tint glass which revolves on the pin and the same effect is produced as in the Beale's pattern, excepting that there is no reversal of the sides.

I can strongly recommend the trial of this little device. Much of the failure in drawing with camera lucidas is due to the attempt to use eyepieces of too high power. It will be invariably found that an eyepiece magnifying six diameters or even less is the most satisfactory, and this equally applies to Ashe's Camera Lucida.

COLORR-PHOTO-MICROGRAPHY.—It has often been deplored that although very exquisite reproductions of delicate structure can be made by photo-micrography, no satisfactory means have been available for reproducing exquisite colour tints, which make the vision of numerous objects through the microscope so entrancing. Attempts have been made, and not without a marked degree of success, by means of the tricolour process of Ives and others, but it called for a high degree of technical skill, and a vast amount of patience, experiment, and time.

The Sanger Shepherd process of natural colour photography overcomes the majority of the difficulties which prevented workers from embarking on attempts in this direction. It is true that the results cannot be printed on paper, but must be viewed as transparencies; but they admit of ready exhibition through a projection lantern, and for direct examination can be held or supported towards a suitable white backing.

The great advantage of it is that no alteration has to be made to the ordinary camera. The recommended adaptation to the camera consists of a repeating back to carry three plates. Immediately in front of these plate-

holders are fixed colour screens, which are guaranteed to be of exactly the correct absorption, and are adjusted by an improved form of Sir W. De W. Abney's colour sensitometer.

Three negatives of the same subject are taken, each with its appropriate colour filter. One print is taken from each of these negatives, and then stained by means of special solutions which are supplied. The three prints are then bound together in superposition to form a finished picture, and the result, if care has been exercised, is very fine.

Those who are in the habit of lecturing on microscopical subjects, or who have hesitated to do so because they cannot sufficiently reproduce the natural appearance of objects, should make a trial of this process, and a very little practice with it will cause them to be gratified with the results.

TO VIEW MULTIPLIED IMAGES—in the facets of the cornea of a beetle's eye is quite simple. An easy method of doing it is to place on the mirror a small cross cut out of black or brown paper, about $\frac{3}{8}$ " long; illuminate in the usual way and focus the facets with $\frac{1}{2}$ " objective. Then gently rack the objective upwards from the object, at the same time moving the paper cross on the mirror, very slightly, with a needle point, and the cross will appear in each of the facets. The needle itself will probably indicate the direction in which the cross should be moved in order to view it in the centre of the facets. The real secret lies not in focussing the facets themselves sharply, but in racking the body upwards until the cross comes into view, and focussing that sharply.

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

ROYAL MICROSCOPICAL SOCIETY.—June 19th, William Carruthers, Esq., F. R. S., President, in the chair. At the

special general meeting several alterations in the by-laws were put and agreed to unanimously. At the ordinary meeting Mr. T. H. Powell exhibited *Coscinodiscus asteromphalus* under a new 1-40 inch apochromatic oil-immersion objective; Mr. J. W. Gordon read a paper entitled "An Examination of the Abbé Diffraction Theory of the Microscope," in which he stated that the above long-accepted explanation of the phenomena of high-power microscopic observation had been adopted on insufficient proof, and would not bear the test of critical examination. The Abbé theory claimed that pictures formed by the microscope of very minute objects were due to diffraction images originated by the object, and that when the oblique rays of light by which these diffraction images existed were excluded no image of the object was possible. This theory had been experimentally illustrated by Professor Abbé by means of a grating on the stage of the microscope and a series of diaphragms behind the microscope object-glass with slits to partially exclude oblique rays. Mr. Gordon showed that, although under such favorable circumstances diffraction effects were produced by fine objects on the stage of the microscope, these effects did not appreciably influence the form of the image. He also showed that the experimental results produced by the above-mentioned diaphragms, which were adduced to prove the theory, were due to a diffraction effect produced by the diaphragms themselves, and not by the grating on the stage of the microscope, the same results being obtained with an aerial image of a grating projected upon the stage by a lens in place of the actual grating. He maintained that in the microscope, as in the telescope, it was necessary to eliminate diffraction effects as far as possible by making lenses of larger aperture, and not, as in Abbé's theory, to include as many diffraction phenomena as possible. Diagrams in illustration of the paper were thrown upon the screen, and

the various experiments referred to were exhibited under a number of microscopes. Professor S. Thompson regretted that he had not heard the first part of the paper, and had not had time to read the advance copy of the paper which had been sent to him. He entirely agreed with Mr. Gordon in rejecting the explanation of the Abbe theory given by Nageli and Schwendener, but found himself at variance with Mr. Gordon on almost every other point, and proceeded to discuss several conclusions arrived at in the paper. Mr. Julius Rheinberg having criticised the paper adversely at considerable length, Mr. Conrad Beck said he did not think it possible for anyone who had followed the experiments described by the author to dispute his contention that the effects observed were produced by the diaphragm behind the objective. The proof that the effects were entirely due to this was shown by the fact that if any of the conditions were altered the experiments did not succeed, and there was no reason why they should not succeed if the Abbé theory were correct. Mr. Gordon contended that he was entitled to the support of Professor Thompson, notwithstanding the impression his speech had probably left on the minds of those present. Professor Thompson agreed with him in throwing over Nageli and Schwendener's explanations, but considered it wrong to throw over the Abbe theory; whereas the quotation at the beginning of the paper made it clear that Professor Abbé had himself thrown it over. In doing so, however, he had promised to elaborate it further. As he had not yet done this, one was obliged to pick it up where it might be possible to find it, and so he was obliged to go to Nageli and Schwendener's book.

THE BRYOLOGIST.

A quarterly journal devoted to the study of North American Mosses
Subscription price fifty cents. Sample copy 15 cents. Mrs. A. M. Smith, 78 Orange Street, Brooklyn, New York.

NEW PUBLICATIONS.

MICROSCOPICAL ANALYSIS OF DRUG POWDERS.—An atlas for all apothecaries, druggists and students of pharmacy. By Dr. Ludwig Koch, Professor of Botany, at Heidelberg University. Appearing in parts—3d Fasciculus. Leipzig and Berlin. The Borntraeger Bros., 1901.

The third fasciculus of this superb work, which completes the first volume, is just at hand and is in every respect well worthy of those that have already appeared and of which we have heretofore spoken at length. The present number finishes up the Barks and takes up and finishes the Elements of Wood Fibres, Wood Parenchymata, etc. Four plates (from X to XIV) and two tables.

We desire to impress upon students of pharmaceutical microscopy the importance of this work. Nowhere else, in all the literature of the profession, can the microscopical structure of this most important part of the stock of every druggist, be found so plainly and excellently depicted. In the text all the methods and procedure are fully explained, so that with the book in hand the druggist is always in position to thoroughly test the purity of his powdered drug.

The price of the volume just completed is 12 marks, and in accordance with the announcement made originally, that of the second volume will be 15 marks. It is obtainable only on subscription, which may be made at a bookstore, or sent directly to the publishers at Berlin.

SANITARY INVESTIGATIONS OF THE ILLINOIS RIVER.—The Illinois State Board of Health has issued a report on the Sanitary Investigations of the Illinois river and its tributaries and the sewage coming from Chicago and the Des Plaine and Illinois river prior to and after the opening of the Chicago Drainage Canal. ("Identification of Bacteria Found in the Waters of the Illinois River and its Principal Tributaries."—The Illinois State Board of Health,

Springfield, pp. 219, one map, 1901.) Dr. Zeit and Dr. Fatterer conclude from the results of their bacteriological studies, that the number of bacteria increase with high water and decrease with low water. Seriously polluted water becomes pure again after flowing for some distance. Pathogenic as well as sewage bacteria decrease as the organic matter decreases, but water bacteria increase. The presence of saprophytic bacteria will hasten the removal of organic matter and the death of pathogenic bacteria. The authors did not succeed in finding any typhoid fever bacilli. Experiments indicate that they die in a few days in Lake Michigan tap water. The addition of boullion keeps them alive a somewhat longer time, but when saprophytes are added at the same time, exhaustion of food supply again causes early death. The *Bacillus coli-communis* may be found in water without sewage pollution and if found may not be virulent. Bacterial purification begins at Joliet. Sewage bacteria decrease markedly at Morris and still more at Ottawa where the bacteriological flora of Illinois river and Fox river do not reveal great differences. Among the pathogenic bacteria found were Anthrax and Tetanus. The *Coli-communis* was found 55 times; *B. lactis aerogenes*, 16 times; *B. enteritidis*, 10 times; *Proteus vulgaris*, 40 times; *P. mirabilis*, 3 times; *B. pyocaneus*, 2 times; *B. tetani*, 3 times; *Staphylococcus pyogenes aureus*, 3 times; *B. anthracis*, 2 times. L. H. PAMMELL.

Outfit for Sale.—Objectives: 1-5" R. & J. Beck, adjustable, $\frac{1}{2}$ " and 1 $\frac{1}{2}$ Elliot Bros. adjustable; One bull's-eye condenser, large, never used; One silver side reflector; One stage forceps; 2 life boxes, one large and one small; 20 slides of arranged diatoms, test plates, costing me some \$30 alone. My eyesight having suffered, (else I should not sell), I will take \$50.00 for the whole.

W. C. Pollner, Cleveland, Ohio.

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Diatomaceae of Gage's Pond, Topeka, and of Silver Lake.

GEO. H. CURTIS.

Although the Diatomaceae of the eastern United States have been pretty thoroughly investigated by several competent observers, I believe that little is known as to what forms exist in the West. With the exception of Thomas and Chase's catalogue of the Diatomaceae of Lake Michigan, which embraces 34 genera and 214 species, and my own catalogue of the Cincinnati forms, 42 genera and 972 species, there are no investigations of western or central-western forms known to me.

In company with Mr. Frank Patrick, I paid a visit to Gage's pond, in the western suburbs of Topeka, about the middle of October. It was dug by Mr. Gage a number of years ago as a fish-pond and stoned up. I did not think of estimating its dimensions while there, but is

perhaps 150 feet long by 50 feet wide, and two or three feet deep. Our object in visiting it was to ascertain if it contained diatomaceous material; and, while there, I made a gathering which, when cleaned up a few days afterward, yielded some very interesting slides, and some *Naviculæ* not previously met with elsewhere.

The most abundant form in the gathering was *Epithemia gibba*, both the long and the short varieties. The most common *Navicula* was *radiosa*. *Cymbella stcmatophora* of several sizes was also common; and *Amphipleura pellucida*, a rare form, more than usually abundant. My gathering was made on the east side, about midway; and it was rather curious that there was no *Amphipleura* in Mr. Patrick's gathering, made only a short distance away at the south end, or from the under sides of the leaves of the water-lilies, of which many were growing in the pond. *Synedra ulna*, var. *longissima*, was abundant, especially in Mr. Patrick's gathering. *Gomphonema* was rather rare. There was a considerable number of large, somewhat curved, sponge spicules. *Navicula cuspidata* was a prominent form—both the long and the short varieties. *Cymbella*, usually one of the most abundant forms in any gathering East, was very scarce at Gage's pond, as well as *Gomphonema*.

The most noticeable thing about the gathering was the remarkable predominance of the rare form, *Epithemia gibba*, of which there were, in a field taken at random, under a quarter-inch objective, no less than seventy-eight individuals, as compared to nine *Cymbella*, four *Navicula*, thirteen *Syndra*, and four *Denticula*—almost three times as many as all the other forms together.

As some may not have had experience with the microscope, I would say that the field of view mentioned above was round, and one-fiftieth of an inch in diameter. This will convey some idea of the exceedingly minute size of these diatoms: that 108 of them, as mentioned above,

could, without any crowding whatever, be placed in a circle of that size.

To give an idea of the rarity of *Epithemia gibba* at other places, I may say that, in the forty-four slides from which my catalogue of the Cincinnati Diatomaceæ was drawn up, representing about thirty different gatherings, this diatom is found in only two of them. In a very remarkable gathering I made from the Fox river, at Elgin, Ill., a half-inch mount of which contained ninety-four recognized species, only two *Epithemia gibba* were observed, and in one from a pond in Oakwood park, Elgin, none; nor were there any in fine gatherings made at places so widely scattered and generally representative of the West and South as Lake Geneva, Wis., Hailey's Springs, Idaho, or Calera, Ala. There were none in a gathering I made from the Chicago water-supply, though it is catalogued in Thomas and Chase's Diatomaceæ of Lake Michigan, from which the city water-supply is derived. Two fine gatherings made in northeastern Ohio, near Ashtabula, contained no *Epithemia gibba*. A gathering made early in October from the fountain basin on Twelfth street, two or three blocks southwest of the capitol, in Topeka, contained hardly anything else but this *Epithemia*; so that its abundance here seems to be a remarkable peculiarity of this locality, depending, perhaps, on some constituent of the water-supply unusually favorable to it. If so, it must, I imagine, be derived from the Republican branch of the river, as a gathering I made from the Blue at Beatrice, Neb., last year, contained none of this diatom.

In connection with *Amphipleura pellucida*, mentioned above, it is not only very rare, but is placed at the end of Moller's test plate as the most difficult test object known to microscopists, and is stated in scientific text-books to be the smallest regularly organized thing known. Of course, the delicate markings referred to below are not

visible at 775 diameters, and the lines across the middle are merely a very coarse imitation of them, to show their direction, etc.

Mr. Patrick informed me that he very carefully examined the alga the *Amphipleura* was growing on and found it to be *Cladophora fracta* Kg., which I believe only grew over a small space on the east and north walls, a fact very interesting, as showing that it is probably parasitic on this alga, and only found in connection with it, something not before observed, so far as known to me. This would account for its not being found under the lily-pads, or at the south end, where this alga did not grow. The rarity of this diatom may be due to the fact that this alga does not grow everywhere.

I once measured *Amphipleura pellucida* by a Rogers stage micrometer, and found it not quite one two-hundredths of an inch in length. The smallest grains of ordinary sand which can be picked up with a pair of watchmaker's tweezers and arranged as close together as possible under a magnifying glass go only sixty-four to an inch, so that the length of this diatom is only a little over one-quarter of the diameter of one of the finest grains of sand; yet in this short length it is marked with 340 of the finest and most regular lines ever seen ruled across it, and each line apparently composed of rows of beads. I counted these lines on an excellent photograph of it, by Doctor Detmers. A list of the genera and species found at Gage's pond is as follows:

Achnanthes minutissima. *Amphipleura pellucida*. *Amphora lilyca*; *ovalis*. *Cocconema australicum*; *cistula*; *lanceolatum*; *mexicanum*; a large unknown, perhaps new. *Cymatopleura elliptica*; *solea* (both long and short). *Cymbella gastroides*; *stomatophora*; *turgidula*. *Denticula elegans*; *tenuis*; *thermalis*. *Diatoma tenue*. *Encyonema lunula*; *turgidum*. *Epithemia gibba*; *gibba*, var. *ventricosum*; *sorex*, short form. *Eunotia gracilis*; *lunaris*; *lunula*. *Fragellaria intermedia*; *mutabilis*.

Gomphonema abbreviatum; *affine*; *affinis*; *angustatum*; *angustatum*,

var. *intermedia*; *angustatum*, var. *producta*, Grun.; *commutatum*; *constrictum*; *gracile*, forma *parva*; *lagenula* Kg.; *mexicanum* Grun.; *obtusatum*; *olivaceum*; *parvulum*; *parvulum*, var. *subcapitata*. *Melosira* *lyrata*, var.(?). *Meridion* *circulare*.

Navicula *acrospheria*, var.(?); *arenaria* Donk.; *bacilliformis*; *biiceps* Ehr.; *brebissoni*; *cuspidata*; *decurrens* (Pinn.); *divergens*, forma *minor*; *elliptica*, var. *oblongella*; *flanatica*; *gibba* (Pinn.); *hemiptera*; *interrupta*; *lanceolata*; *lanceolata*, var. much smaller; *mesolepta*; *nodosa*, var.; No. 15; No. 44; No. 45; No. 55, Schmidt's Atlas, pl. 7, with some reserve; *oculata*; *oblonga*; *peregrina*; *producta*; *pseudobacillum*; *radians*; *radiosa*; *radiosa*, var. *acuta*; *retusa*; *rhyncocephala*; *rostellata*; small, elliptical, coarsely marked; *schumanniana*; *stauroneiformis*; *stauroptera*; *stomatophora* Grun.; *subinflata*; *tabellaria* Grun.; *trinodis*; *ventricosa*, forma *minuta*; *viridis* (Pinn.); *viridula* Kg., forma *minor*.

Nitzschia *frustulum*; *sigma*; small, unknown, coarse markings. *Pleurosigma* *spencerii*. *Stauroneis* *anceps*; *phoenicenteron*; unknown, small. *Surirella* *apiculata*; *molleriana*; *ovata*; *ovata*, var.; *panduriformis*; *suevica*. *Synedra* *crotonensis*; *danica*; *familiaris*; *pulchella*; *superba*; *ulna*, var. *longissima*; *ulna*, var. *vitrea*.—Total genera, 21; species, 108.

Many more might undoubtedly be discovered by devoting time to the more thorough examination of the slides, as I never sit down to them without finding something new. As sixty species is a fair average for the best gatherings, it will be seen that this at Gage's pond was unusually good. A gathering made at Silver Lake, twelve miles west of Topeka, yielded much the same forms, except that in a half-inch mount of it only two *Epithemia gibba* were observed, and with the following additions:

Achnanthes *hudsonis*; *exilis*; *lanceolatum*. *Cocconema* *cistula* (a new variety). *Cyclotella* *comta*; *meneghiniana*. *Cymatopleura* *apiculata*. *Encyonema* *triangulum*. *Fragellaria* *turgens*. *Gomphonema* *affine*, forma *major*; *gracile*. *Melosira* *crenulata*; *varians*. *Navicula* *ambigua*; *ampliata*; *confervacea*, var. *peregrina*, Grun.; *lanceolatum*; *sphaerophorum*. *Nitzschia* *dissipata*; *hungarica*; *paradoxa*; *sigmoidea*; *tryblionella*, forma *minor*; *tryblionella* forma *densus striatæ*; *tryblionella*, var. *victoriae*. *Pleurosigma* *eximium*; *hippocampus*(?); *delicatulum*. *Surirella* *intermedia*. One additional genus, *Cyclotella*, and twenty-nine species.

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Disinfection Against Mosquitoes.

M. J. ROSENAU, P. A. S.

Until lately, mosquitoes and flies were looked upon merely as annoyances, but since it has been proved that they are able to transmit the infection of pestilential diseases, we must now regard them as dangerous vermin. When the matter is generally understood, it will be a greater reproach to the housewife to have mosquitoes and flies in the home than bed bugs, and it is the duty of sanitarians to spread an abhorrence for these most common and most dangerous of domestic pests. The mosquito is known to transmit the infection of malaria and filariasis. That the mosquito transmits yellow fever must now be accepted as an established fact. The next problem is the destruction of the infected mosquitoes.

It is a well-known fact that formaldehyd gas readily enters into combination with the protoplasm of the lower forms of vegetable life, which makes it a very efficient germicide. It is, however, not toxic to the higher forms of animal life. It is very irritating in its effect upon the mucous membranes of rats, mice, guinea pigs, rabbits, and mammalian animals generally, but not necessarily fatal, even after prolonged exposures. Many insects, such as roaches and the like, may be exposed to strong concentrations of the gas a long time without effect.

Formaldehyd gas kills mosquitoes whenever the gas comes in direct contact with them in sufficient concentration and for a sufficient length of time. When exposed *directly* to the gas produced by any of the methods commonly used for disinfecting purposes, the mosquitoes die within a few minutes. If the insects are confined in a bell jar and some formalin is dropped inside, they soon show signs of agitation and shortly drop down, dead. They may, however, live over night in a very feeble atmosphere of the gas.

The conditions necessary to obtain this direct contact, however, can not always be obtained in actual practice. Rooms are frequently not tight enough to obtain the concentration of the gas required. The mosquitoes can not be held in direct contact with the gas, for their sense of self-preservation helps them to escape. The period of irritation, lasting several minutes even in the bell jar, enables the insects to hide in available places, such as the folds of garments, hangings, or fabrics, or in the cracks and crevices where the gas only reaches in a diluted form. If the room is not thoroughly sealed, some of the mosquitoes will surely get away, for their instinct in finding tiny avenues of escape is remarkable. The escape of one infected mosquito might be the spark that would rekindle an epidemic.

In general, it may be stated that to succeed in killing mosquitoes in a closed space with formaldehyd gas, the following definite requirements are essential. A large volume of the gas must be liberated quickly, so that it may diffuse to all portions of the room in sufficient concentration. The room must not have cracks and chinks where the insects will breathe the fresh air entering, especially if these openings are to windward. The room must not have heavy drapery, clothing, bedding, or other fabrics, so disposed that the insects may hide in the folds, away from the full effects of the gas.

In order to compare the merits of formaldehyd with sulphur dioxid gas in disinfection against mosquitoes, experiments were made by burning sulphur and with the liquid sulphur dioxid gas.

The power of sulphur dioxid to destroy all forms of animal life is well known. On account of its destructive action upon fabrics and metals, this agent is of little practical use in the disinfection of dwelling houses, cabins of ships, and similar places. This destructive action is due to the moisture which combines with the sulphur

dioxid to form sulphurous acid, which is the real disinfecting agent. Dry sulphur dioxid has practically no effect upon bacteria. Our work has shown that very small atmospheres of the dry gas will quickly destroy mosquitoes, and we therefore believe that the destruction of these insects may be accomplished in dwelling houses with little danger of injuring fabrics or tarnishing metals. Sulphur dioxid is so far superior to formaldehyd as an insecticide that even the risk should not outweigh the certainty of its action. The gas may now be obtained in its liquefied form, either in tin cans, in syphons, or in iron cylinders, affording very convenient methods of quickly introducing a given amount of the dry gas into an inclosure.

A series of experiments was also made to determine whether chemically dry sulphur dioxid has insecticidal properties. It is well known that the anhydrous gas has practically no effect upon bacteria. As the dry gas is not destructive to fabrics and metals, it is of considerable practical importance to know whether it will kill mosquitoes.

To this end the liquid sulphur dioxid was liberated in a bell jar, but first passed through 2 drying columns containing pumice stone saturated with sulphuric acid. The moisture contained in the air of the bell jar was eliminated in 2 ways, (1) by drawing air through the drying columns into the bell jar, or (2) by introducing calcium chlorid into the bell jar. It was found, in all these tests, that the mosquitoes were killed, practically instantly, by the dry gas.

Contrary to formaldehyd, which requires an exposure and strength of gas sufficient to destroy spores in order to entirely rid a room of mosquitoes, sulphur dioxid will kill these insects even when the quantity of the disinfectant and the time of exposure are reduced so that non-spore-bearing bacteria are unharmed. Sulphur dioxid

was for a long time used as a disinfecting agent against yellow fever, and experience found it to be trustworthy. But later it was disparaged because laboratory tests showed that it lacked the power of killing spores and has little penetrating power through fabrics. But now that we know it is the mosquito which carries the infection, the usefulness of this agent is revived.

Formaldehyd gas is a feeble insecticide. Mosquitoes may live in a very weak atmosphere of the gas over-night. It will kill them, however, if it is brought in direct contact in the strength and time prescribed for bacterial disinfection. For this purpose any of the accepted methods for evolving the gas is applicable, but the methods which liberate a large volume in a short time are more certain than the slower ones.

Direct contact between the insects and the gas is much more difficult to obtain in ordinary room disinfection against mosquitoes than against germs, because the sense of self-protection helps the former to escape from the effects of the irritating gas. They hide in the folds of towels, bedding, clothing, hangings, fabrics, and out-of-the-way places where the formaldehyd gas does not penetrate in sufficient strength to kill them. The gas is polymerized and deposited as paraform in the meshes of fabrics, which prevents its penetration, and large quantities are lost by being absorbed by the organic matter of fabrics, especially woolens. In our tests, whenever the insects were given favorable hiding places, such as in crumbled paper or in toweling, they quickly took advantage of the best place for themselves and thus escaped destruction.

There is a striking analogy between the strength of the gas and the time of exposure necessary to penetrate the fabrics in order to kill mosquitoes, and the strength and time necessary to penetrate in order to kill the spores of bacteria.

Mosquitoes have a lively instinct in finding cracks or chinks where fresh air may be entering the room, or where the gas is so diluted that they escape destruction. They are able to escape through incredibly small openings. Some of the smaller varieties, such as the *stegomyia fasciata* can get through a wire screen having 12 meshes to the inch. Therefore, formaldehyd gas can not be trusted to kill all the mosquitoes in a room which can not be tightly sealed.

It is concluded, that to succeed in killing all the mosquitoes in a closed space with formaldehyd gas, the following definite requirements are essential: A very large volume of the gas must be liberated quickly, so that it may diffuse to all portions of the space in sufficient concentration. The room must have all the cracks and chinks where the insects may breathe the fresh air carefully sealed by pasting strips of paper over them. The room must not contain heavy folds of drapery, clothing, bedding, or fabrics in heaps, or so disposed that the insects may hide away from the full effects of the gas.

Sulphur dioxid is unexcelled as an insecticide. Very dilute atmospheres of the gas will quickly kill mosquitoes. It is quite as efficacious for this purpose when dry as when moist, whereas the dry gas has practically no power against bacteria. Contrary to formaldehyd it has surprising powers of penetrating through clothing and fabrics, killing the mosquitoes, even when hidden under 4 layers of toweling, in one hour's time—and with very dilute proportions.

This substance, which has so long been disparaged as a disinfectant because it fails to kill spores, must now be considered as holding the first rank in disinfection against yellow fever, malaria, filariasis, and other insect-borne diseases. A pamphlet giving in detail all the experiments by which the above conclusions were reached can be had from the Marine Hospital Bureau.

Structure of Diatoms.

FRANK J. KEELEY.

In studying the structure of diatom valves some years ago, the method employed, mounting broken valves at right angles to the cover glass, proved efficient for most of the coarsely marked forms, but failed with certain species of *Aulacodiscus*.

Such forms as *A. sollittianus*, *A. margarataceous*, etc., yielded satisfactory sectional views and proved not to differ materially in structure from *Coscinodiscus* but another group, including *A. oreganus*, *A. rogersii*, *A. jani-schii*, etc., proved too opaque for the elucidation of their structure by this method. Further examination of fragments in which the plates were separated indicated, however, that the typical "honeycomb" cellular structure was likewise present in these species, but masked by the unusual character of the external plate, which differs from that of other diatoms in having the finer secondary structure between, rather than over, the large cells of the middle plate.

Recently, with the view of further determining the relations of this structure to that of other species, a special mount was prepared, including *A. oreganus*, *A. rogersii*, with typical species of *Concinodiscus*, *Triceratium*, *Actinocyclus*, *Actinoptychus*, etc. The various forms were arranged in a line on a square cover-glass, supported on the slide by bands of cement at two opposite edges, thus permitting the fluids of varying refractive indices to be passed under the cover and withdrawn by the use of blotting paper in the manner familiarly known as "irrigation."

The fluids employed consisted of absolute alcohol, cedar oil, oil of cassia and mixtures of same, giving refractive indices from about 1.37 to over 1.60. Starting with the lowest refractive index, the appearance of each diatom was carefully noted under low, medium and high aperture

objectives, and it was found that all the species represented, with the exception of the two *Aulacodiscii*, became fainter as the refractive index was increased up to about 1.435, when they were entirely invisible, except where in contact with the cover-glass. As the index of the medium surrounding them was increased above this point they became more distinct, the coarser forms being almost opaque in oil of cassia. This is exactly what should be expected, either on theoretical grounds or based on previously published experiments, but in the case of the two species of *Aulacodiscus* mentioned, the distinctness of visibility under a low power seemed to increase from the start, and in the medium where other forms disappeared they were even more strongly outlined than in alcohol, while under an oil immersion-objective no difference could be noted in the sharpness and contrast with which the secondary structure was shown in any of the various fluids, although portions of the internal plates, which extended beyond the external plate in broken forms, were extinguished with the rest of the diatoms on the slide, showing that the anomalous behavior of these species was confined to the external plate, containing the secondary structure. Neither heating to redness on platinum foil nor boiling in strong acids has the least effect on the appearance of the secondary structure, nor is there anything to indicate that its appearance is due to difference in composition rather than of structure. With the facts at present available it would be useless to hazard a conjecture as to the true nature of this structure, but it may be safely affirmed that in the external plate of this group of species of *Aulacodiscus* we have a structure essentially different from that found among other diatoms.

Aulacodiscus Oreganus is one of the few diatoms that show bright colors with central transmitted light. The two valves of this species included on slide under observation, when examined with a three-fourths-inch objec-

tive of .25 N. A., were bronze-yellow when dry, yellowish gray in alcohol, blueish gray in medium of 1.41 R. I., iridescent blue in medium of 1.44 R. I., deep greenish blue in cedar oil, dark green and pink in oil of cassia.

The question of colors shown by diatoms in direct light has recently been treated in the Journal of the Quecket Club, with special reference to *Actinocyclus ralfsii*, by E. M. Nelson, who has shown that the color cannot be due to diffraction. The two valves of *A. ralfsii* which were included in the previously described slide showed only pale brown and grayish tints in media of R. I. below 150, and extinguished with the other forms in one of R. I. about 1.43. In cedar oil one valve showed a blue color and in oil of cassia both became brilliant with green, blue, purple and yellow. Under wide aperture objectives the color is not visible when diatom is sharply in focus, but it appears as soon as thrown slightly out of focus. This color appears to be due to dispersion, and its nature and cause might possibly be further elucidated by studying the effect produced by different media such as were employed in this case.—*Proc. Phila. Acad. Natural Sciences*.

Diatoms, The Food of Fish in Kansas.

GEO. H. CURTIS.

Mr. S. G. Mead, of McPherson, gave me a small fish about two inches long, which he caught at Belvidere, Kiowa county, Kansas, last fall. It was apparently a young perch, to judge from its shape and the dark bands along its sides. Having a curiosity to know what its food had consisted of, I undertook a microscopical examination of the contents of the digestive tract; but the difficulty of arriving at satisfactory results was much increased by the carbolic acid and oil the fish had been preserved in, which interfered very much with the proper

action of chemicals, especially acids, and did not seem to yield well to either soap, benzine, or alcohol.

The investigation was, therefore, not altogether so satisfactory as I could wish; but was sufficiently so to establish the main points, and to prove that their food consists very largely of diatoms, mostly *Naviculæ*, of the *radiosa* type; of which I was able to make a very satisfactory examination, to be referred to again further on. There were also many starch grains, shown by the polariscope to be those of the potato, and about as many, perhaps, which were smaller, and possibly derived from bits of bread. There were also a number of green bodies of roundish contour, which were without much doubt desmids. They had been too long subjected to the action of the gastric secretions for the species to be exactly made out, but they were probably *Cosmariums* of some sort; and their numbers were apparently too small for them to have formed a very important part of the fish's diet. About a dozen grains of corn-smut were met with, all in one place.

There was a very considerable quantity of white sand in the stomach and intestines, hardly any field of view in the microscope one-fiftieth of an inch in diameter being without a number of grains of it. They were generally of about the same size as ordinary river sand, and polarized equally well. In one field of the size mentioned above there were thirteen grains of it, in another nine, and in a third five, of three taken at random. It may be possible, though hardly probable, that this sand was swallowed accidentally. It is, however, far more likely that it was swallowed designedly, to aid the process of digestion, as is the case with birds; and the size of these sand grains would, considering the difference in size of the two creatures, apparently bear a just proportion to the little stones swallowed for this purpose by fowls.

They may also have been swallowed to act by their

weight as ballast to counteract the natural buoyancy of the body, like the stones of considerable size usually found in the stomachs of alligators, and which are supposed to have been swallowed to assist them in remaining at the bottom.

The fact that there were no grains of black sand among it, which does not polarize, would rather seem to lend support to the digestive theory; inasmuch as white sand, being composed of quartz, or almost pure silica, and hard enough to scratch glass, would naturally be selected by them to assist in the grinding or trituration of their food, rather than the much softer black sand.

There was observed at one place an agglomeration of small, round grains, quite smooth outside, like very small fish eggs, which they perhaps were, or spores of some small toadstool or other fungus. They were transparent, and not much over one-quarter the size of the grains of sand mentioned above.

A great quantity of some dark-colored substance, finely comminuted and apparently of animal origin, was found, perhaps the remains of worms or meat of some kind; but, although most carefully sought for, there were no feet, wings, scales of lepidoptera, parts of insects, crustaceans, or muscular fibers of any sort among it, such as would have been likely to have survived the digestive process and given a clew to its character.

As we may see from the smallness and degree of convexity of their eyes that fish must be capable of seeing things infinitely smaller than would be visible to the human eye, this matter was perhaps composed of minute particles of both animal and vegetable origin which the fish met with and swallowed as it swam about, and which were perhaps too small to preserve any definite recognizable character, especially after passing through the stomach.

Their principal food, though, to judge from the great

numbers of frustules of different kinds found in the stomach and intestines, were diatoms, the outer shells of which being composed of almost pure silica, are well-nigh indestructible by the digestive process, fire, or the strongest acids.

After preparing the diatoms for examination under the microscope, it was seen that the greater part of these small organisms in view were *Navicula* of small size, of the type known as *radiosa*, *arenaria*, etc., of two or three sizes, or of the *lanceolata* form, with divergent striæ, such as are figured in Schmidt's Atlas of the Diatomaceæ (plate 47) or varieties of that type. Some were much larger and some smaller, but mostly of the same general type.

Gomphonema was, as usual in Kansas gatherings, very rare, though four or five species were met with. *Cymbella*, also one of the commonest forms anywhere East, was equally scarce; and I had about concluded that none except small forms were present, when I unexpectedly came across an *Amphiprora* of the largest size, and of a decidedly rare variety, not found in the forty-four Cincinnati slides. The individuals of this family are among the largest diatoms; and they were remarkably abundant, as if there was a savor or a large body of nourishment in them which had especially appealed to the fish's taste.

A noticeable thing was not only the abundance of this large and rare *Amphiprora* not found at Gage's pond or Silver Lake, but the remarkably large number of fine *Pleurosigma*, mostly *spencerii* or varieties, every field containing at least one and often several.

An unusually large form of *Amphora lineata*, not found at Gage's pond, Silver Lake, or in the forty-four slides of Cincinnati diatoms, was quite abundant. Only one *Navicula* of the *rhomboides* type was seen, and that was a variety, the *Colletonema vulgare* of Thwaites. *Stauroneis phænicenteron*, one of the few distinctively fresh water forms said to be found everywhere, was not met with.

Epithemia gibba, so remarkably abundant at Topeka, was present, but rather uncommon. Of the three or four species of *Nitzschia*, only one seemed to be of a common variety, and one of them, *Nitzschia sigma*, is catalogued by different authorities as a marine form. A most remarkable thing was that not a single *Surirella* of any kind was seen in the three slides mounted. As they are one of the most abundant forms everywhere, and there being plenty near at Medora, we must either conclude that there were none where the fish lived, or that they possessed some poisonous or other undesirable qualities which caused him to reject them.

One of the most remarkable things found was *Mastogloia*. The genus is almost exclusively marine or brackish, and only one of the two species are ever found in fresh water, and they are excessively rare. This one, *M. lacustris*, was not found at Cincinnati; though an allied species, *M. lanceolata*, was recognized there with some slight reserve. It is also catalogued by Thomas and Chase, but none of either was found at Gage's pond or Silver Lake. Another seems to be what Grunow calls *Nitzschia apiculata*, though the blank line down the center and the absence of alae seem to identify it with *Synedra*.

To give an idea of the relative proportions of the genera present in a field of view one-fiftieth of an inch in diameter, selected merely because it had an *Amphiprora* in it, so as to include that, there were the one *Amphiprora*, one *Amphora*, one *Cymbella*, two *Nitzschia*, three *Pleurosigma*, and thirty-four *Navicula*.

The genera and species, so far as observed, were as follows:

Amphiprora conspicua (?), (perhaps *columetica*?); *paludosa* W. S., said to be British. *Amphora* *cymbifera* Greg.; *lineata*; No. 18, Schmidt's Atlas, pl. 39. *Cocconeis* *pediculus*. *Cocconeis* *australicum* A. S.; *cistula*; *helveticum*; *hungaricum*; *lanceolatum*; *mexicanum*. *Cyclotella* *retula*; a small unknown.

Cymbella affinis; *gastroides*; *helvetica*; *kamchatica* Grun.; *minuscule* Grun.; No. 40 of Sch. 9, not named; *stomatophora*; *tumidula*; *turgidula*; two small unknown. *Denticula splendens*. *Encyonema lunula*. *Epithemia gibba*; *gibba*. var. *ventricosum*; *gibberula*; like *musculus*, but ends not so sharp; uncertain; *zebra*. *Gomphonema abbreviatum*; *angustatum*, var. *intermedia*: *capitatum*; *clavatum*; *commutatum*, var. *subramosum*; *intricatum*, var. *pumila*; *olivaceum*; *olivaceum*, var. *vulgaris*; *ventricosum*. *Homœocladia sigmoidea*. *Mastagloia smithii* Thw., var. *lacustris*, Grun.

Navicula amphiceros (?); *bacillum*; *borealis* (var. small, with nine coarse striæ); *brebissonii*; *cymbula* Donk; *elliptica*; *elliptica*, var. *oblongella*; *gracilis* (Kg.) Grun.; *gregaria* Donk; *interrupta* (Pinn.) S. W.; *lanceolata* (Kg.), var.; *leptogongyla*; *longa*; *macra*; *mutica*, var. *goeppertiana*; large, coarsely marked, lanceolate, unknown; No. 11 of Schmidt's 47, not named; No. 13 of same, not named; No. 15 of same, not named; No. 22 of Schmidt's 44, but rather coarser; No. 32 of Schmidt's 44, with some reserve; *obtusata*; *pumila* Grun.; *radiosa* Kg.; *radiosa*, var. *acuta*; *rhomboides*, var. (*Colletonema vulgare* Thw.); *rupestris* (Pinn.) Grun.; *smithii*(?); *subcapitata*, var. *stauroneiformis*; *subinflata*; *stauoptera*; *stauoptera parva* Grun.; *tabellaria*; *tenella*; unknown, perhaps *naveana*(?).

Nitzschia amphioxys, var. *vivax*; *angustata*; *frustulum*; *heufferiana*; *hungaricum*; *sigma*; *stagnarum* Rabh.; *triblionella*. *Pleurosigma gracilentum* Rabh.; *spencerii*; *sciotense*; *kutzingii*. *Synedra acus*; *crotonensis*; *danica*; *familiaris*; an end of, perhaps. *Chaseii*(?); *pulchella*, forma major; *ulna*.—Total genera, 16; species, 100.

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

PREPARING SMALL MARINE INVERTEBRATES.—The following method of preparing small marine invertebrates for microscopic study may be of service to some of our readers. It was originally contributed to the "Journal of Applied Microscopy" by Mr. H. P. Johnson, the aim being to retain as fully as possible the natural form, transparency, and coloring, and at the same time to have the specimen instantly accessible for re-examination. The specimen is placed on a slide in a few drops of pure sea water, and slightly compressed with a cover-glass provided with wax feet. The compression can be quite accurately regulated by pressing down the wax feet at the

corners of the cover-glass, or prying up the cover-glass, a little at one or more corners with the point of a scalpel. If the specimen is a worm, it will contract at first; but afterwards will usually become fairly extended. After two or three hours the worm, although still living, becomes almost perfectly quiescent. A few drops of a 4 per cent solution of formaldehyde are then run under the cover-glass, its flow being hastened by draining away with bibulous paper an equal quantity of water at the opposite side. The worm should die in a fairly extended condition. A sufficient quantity of formaldehyde should be run under to displace all the sea water. After an hour or so the gradual replacement of the formaldehyde with glycerine may begin. Mr. Johnson has always used undiluted glycerine, but suggests that a mixture of equal parts of glycerine and water might be safer for very delicate objects. The glycerine is applied in the same way as the formaldehyde, but more gradually—only two or three drops at a time. After the specimen has become completely surrounded and permeated with pure glycerine, the mount is sealed with Venice turpentine in the manner explained in Lee's "Vade Mecum," fifth edition, p. 291.

The preparations will keep almost indefinitely without sealing, but with the obvious disadvantages that the glycerine is likely to flow over the slide in moist weather, and a mist gathers on the cover-glass. The preparation should be flat at all times. This method has been found to meet all the requirements of the case for small Annelids and Echinoderms, and would probably be equally successful for a wide range of minute animal forms, excepting always those with impermeable chitinous integuments, like the Arthropods. *Syllidae* and other small Polychetes up to a length of four or five centimetres have been successfully treated, and preparations made three years ago are as beautiful and instructive as at first.

DEMONSTRATIONS OF MICROSCOPIC MANIPULATIONS.—Mr. C. Baker informs us that he has decided to set aside four afternoons in each month from October to the end of June for the demonstration of microscopic manipulation. These demonstrations will be given on the first and third Fridays and second and fourth Tuesdays, from 3 to 6 p.m. Each demonstration will consist of an exhibition of about eight microscopes, together with illustrative diagrams; and the instruments will be set up, ready for inspection, at the times stated, so that those who have but a short time at their disposal will not be delayed by preliminary preparations. Three of the demonstrations will deal with illumination, one with the comparison and testing of objectives, and two with the various methods of recording observations. Further particulars can be obtained from Mr. C. Baker, 244 High Holborn, W.C., and we need only to add that the demonstrations will be free to all, and no obligation to purchase is incurred by those availing themselves of the offer. It cannot be too strongly insisted upon that the modern microscope is essentially an instrument of precision, and requires education in its use if full advantage is to be taken of its capabilities. We hope therefore, that these demonstrations may prove successful.

EDWARD WARD.—A well-known figure in Manchester scientific society was recently removed by the death of Mr. Edward Ward at the age of 57 years. He was born at Coventry, where in his early life he worked as a ribbon weaver. Having a natural taste for scientific investigation, he soon became possessed of a microscope and later of a primitive camera. His tastes quickly brought him into association with others, which led to his leaving the loom for the vocation of commercial traveller. Notwithstanding the difficulties incident upon the constant change of locality when thus occupied, he contrived while on his journeys to study, dissect, stain and mount thousands of

objects. In 1887 he issued his first list of purely scientific lantern slides, which gave an impetus to science work in the district. He was one of the founders of the Manchester Microscopical Society, and for several years one of its presidents, and a lecturer in its Extension Section. It will, however, be on account of his photographic work that he will be best remembered. It is said that he took no less than ten thousand photographs of Geological Sections during the construction of the Manchester Ship Canal, and also of its chief engineering features. To attain such a remarkable pictorial history of that gigantic undertaking, Mr. Ward used at least once a month to walk along the whole course of the works between Manchester and the Mersey above Liverpool during the period of construction, which lasted beyond five years.

C. BAKER'S SLIDE-LENDING SYSTEM.—The system of slide lending—initiated, we believe, by Mr. C. Baker, and since adopted by other firms, such as Messrs. Watson & Sons, of London, and Mr. Abraham Flatters, of Manchester—was a departure that had much to recommend it. Mr. Baker's system, in brief, is that for a subscription of \$5, the subscriber becomes the recipient of twelve deliveries of twenty slides each, post free both ways. These slides can be arranged for delivery at stated times—say, fortnightly during the winter months, or the time of receipt and return can be left to the varying convenience of the subscriber. The choice of slides is most comprehensive; in the list before us we note twenty-five sets of diatoms alone, and four sets of bacteria. The mere examination of slides, however, whether arranged for a definite purpose or not, falls far short in interest and in educational value of the same slides accompanied by the necessary descriptions and explanations. Recognizing this, Mr. Baker has now arranged that full descriptions shall accompany the slides lent, and has given us the opportunity of perusing several of these sets of detailed notes.

The scheme is excellently carried out by competent writers, though the work entailed thereby must have been considerable, as the notes run in each case into many pages. For instance, a set of twenty slides dealing with bacteria is accompanied by a succinct and carefully-written introduction to their study, after which follow detailed descriptions of the respective slides, so that the examination of each becomes a little lesson in itself, the methods of examination and, in certain cases, of preparation not being omitted. Another set of twenty slides deals with Mollusca, and in the accompanying descriptions we recognize a well-known writer on marine zoology. The following extracts will show the nature of these notes.

Dealing with the palates of Mollusca, the writer says: "With but two or three exceptions the mouths of Gastropods and Cephalopods are furnished with a tooth-bearing, ribbon-shaped band, variously known as the radula, odontophore, lingual ribbon, palate, or tongue; an organ of use in scraping, cutting, boring, or masticating, according to the habit of the particular animal. It is often of very considerable length, and consists of an anterior portion working over a cartilaginous swelling, the regular cartilage, upon the floor of the mouth, while the longer hinder portion is lodged and formed within a large radular sac, which in reality is a deep cylindrical depression of the floor of the mouth. When the radular is very long, as in the limpet, the radular sac lies free, folded several times upon itself, within the body-cavity immediately between the viscera and muscular foot disc. Throughout life new teeth are continuously added by secreting cells situated at the blind end of the radular sac; the singly-refractile core of each tooth being secreted by certain cells upon the floor of the sac, while the enamel-like, doubly-refractile outer layer is laid on by those of the dorsal wall.

As mentioned, that part of the radular which is in use plays over a pulley-like cartilaginous cushion, and by the

alternate contraction of two sets of muscles, protractors and retractors, attached at one end to the base of the cushion and at the other to the radula, the latter is dragged backwards and forwards over the cartilaginous pad, as an ostler polishes the inside of fixed rings by pulling a cloth to and fro within. Listen to the limpets as they rasp slowly over the rocks, and you will understand clearly how effective is this radula in scraping off minute vegetation that coats the rock. The sound given out is too definite to be mistaken. The scraping action of the radula is also very easily studied in a fresh-water aquarium containing a few water-snails. As the teeth in front wear down, the ribbon is bodily moved forward sufficiently to permit new teeth to come into use." Then follows a detailed description of the teeth and of the classification.

From notes accompanying a miscellaneous set of slides we extract the following remarks on a slide showing the prismatic raphides in the cuticle of an onion (*Allium cepa*): "Lime enters largely into the composition of all organic bodies. In human bones, for example, the salts of lime constitute 65 per cent of the whole mass, or more than double the amount of animal matter. There are very few plants in which these limey crystals or raphides are not found. They vary considerably in size and shape, and it is by no means difficult to detect them by cutting thin sections of plants and examining them under the microscope. A glass slip, a cover-glass, and a little water are all the mounting materials necessary. They will not, of course, come out so clearly as in a slide made by a professional mounter; but it is always interesting to do something for oneself, and facts observed in this way are firmly impressed on the memory. The simplest form of raphides is to be found in the lilies, where these bodies occur in the form of bundles of needle-like rods occupying the centre of the cell. In the strip from the outside of a lily stem they are seen under an inch as an almost solid mass in

the protoplasm of the cell; but the $\frac{1}{2}$ -inch will resolve this mass into its constituent parts, when the needle-like bodies lying side by side can be made out distinctly. In the onion the raphides are prismatic in form, and may be seen scattered over the whole section; the walls of the cells in which they are enclosed can be clearly made out, and each cell contains a single crystal or raphia."

FORMALIN AS A PRESERVATIVE FOR PLANTS.—The use of formalin for the preservation of zoological specimens is now very general. Its application to the preservation of plants and flowers, however, is quite new. The most satisfactory results are obtained with a 5 per cent solution of formaldehyde, i. e. an eighth of the strength of the commercial formalin, which contains 40 per cent of formaldehyde. The flowers and portions of plants immersed in this and kept in the dark remained intact, whilst the tissues became more or less translucent, showing the structure. After seventeen months, yellow calceolaria flowers had lost but little of their color, whilst a tulip and hyacinth had lost about 30 per cent. A pansy exposed to diffused light in a 5 per cent solution was rapidly bleached, with the exception of the lower yellow petal. A white tulip became translucent, but retained its external form perfectly. The odor of mignonette was still perceptible after four months, notwithstanding the penetrating odor of the formalin itself. Unfortunately the solution soon bleached blue colors. A blue hyacinth became opaque white in two days and translucent in six months. Green leaves became only slightly translucent, and were otherwise unchanged. In order to prevent the bleaching action of sunlight it was found essential to keep the specimens in as dark a place as possible. The preservative action of the formalin is due to its destroying all external micro-organisms, and preventing the interaction of the plant-cells by contracting their protoplasm.—*C. A. Mitchell, London, in Science-Gossip.*

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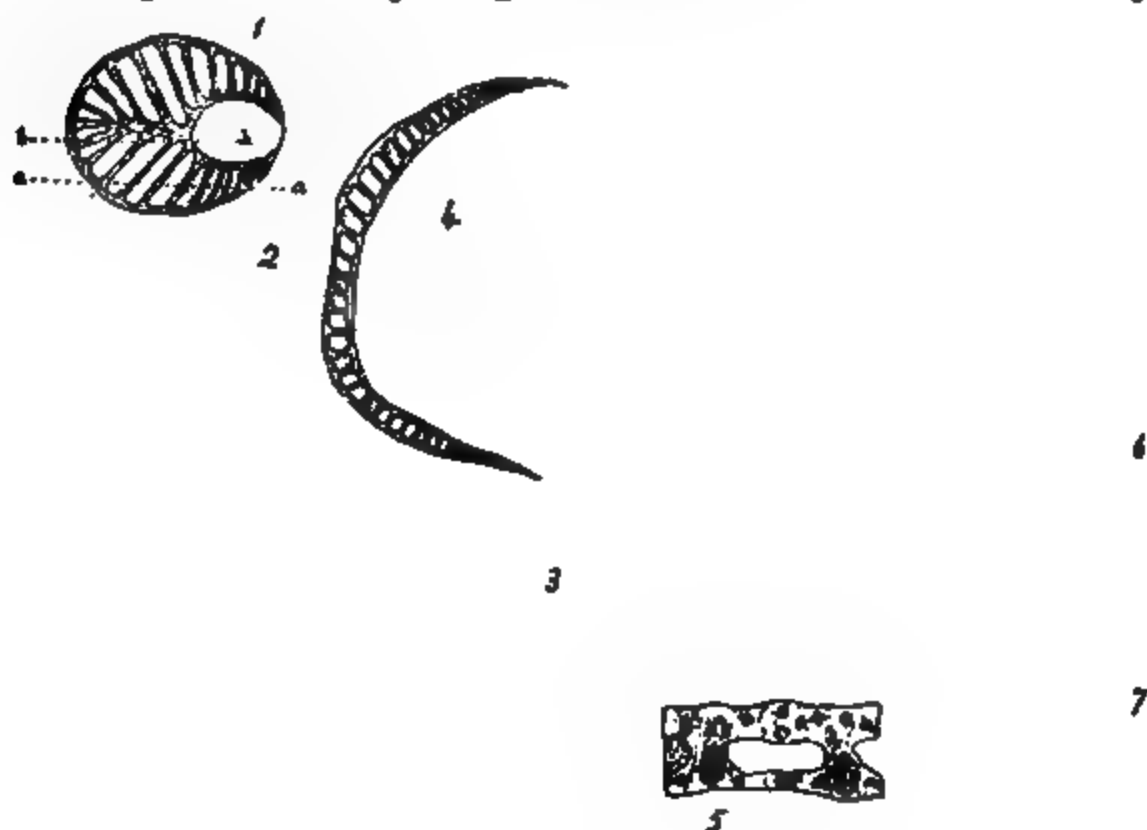
Ethmoid Diaphragms.

JOHN M. ORDWAY.

In some monocotyledonous plants there is a kind of tissue of which there is no description in any botanical work within my reach. This constitutes the cross partitions or diaphragms of the air passages extending the whole length of the petioles, leaves, or scapes. These diaphragms consist of one layer of flat, branching cells which join together so as to leave triangular, square, or oval apertures allowing easy communication between the different compartments of the same longitudinal series. If they have not been already named, they may very properly be called ETHMOID diaphragms,—from Ethmos, a colander.

Good examples are afforded by the tropical banana plant, *Musa sapientum*. Fig. 1 shows a cross section of

- the banana petiole one fourth smaller than the natural size. Fig. 2 represents a short piece of a section cut downwards from the line *a a* of Fig. 1. Fig. 3 gives a portion of an ethmoid diaphragm magnified about fifty times. Fig. 4 is a transverse section, of one half the actual size of a sheath, taken a little below where it narrows and bends out to become the petiole proper. These sheaths extend down to the ground and together form the body of the plant. Air passages with ethmoids also make up



a part of the large red bracts which protect the successive tiers of flowers and are thrown off, one by one, as the fruit develops. Fig. 5 shows a cross section of one them enlarged five times, the upper part being the outside.

The diaphragms, as shown in fig. 2, are hardly two millimetres apart. Therefore if we examine with the microscope several successive cross slices of a petiole, we shall be sure to find among them some that have one or more of the diaphragms in place. Or we may split off the side as in fig. 2, so as to expose the interior, and

then cut just above and just below one of the plates. But it is better to remove the parts outside of *a a* and *b b* of fig. 1 and dissect out one of the diaphragms to examine by itself.

By suitable focussing it will be seen that the cells are somewhat convex. They not unfrequently contain distinct crystals of calcium oxalate as shown at *x*, fig. 3; and occasionally cells filled with raphides may be seen lying on the plates, as at *c*.

But where the *Musa* is not available, good specimens of the diaphragms may be readily obtained from the *Pontederia cordata* which grows in shallow waters everywhere. The petioles which spring from the rhizome consist mainly of sixty or more air-ways with cross plates less than two mm. apart. The flower-bearing stem of this plant has, besides about 150 small air-passages, a large central one in which the ethmoids are about five mm. from each other. After splitting the stem so as to expose this central cavity, one of the plates may be cut loose around the edges and be removed for examination. They are like fig. 3. In almost every transverse section of the stem, ethmoids may be seen in some of the smaller air-ways. And the same is true of the petioles.

Fig. 6 shows a cross section of a *Pontederia* stem of three halves the real size. Fig. 7 gives a short piece in longitudinal section on the same scale. Fig. 8 represents one-sixth of a cross section of ten times the natural size.

Another of the Pontederiaceæ, the very prolific *Eichhornia crassipes* (or *speciosa*), which has taken possession of our Southern bayous, abounds in air-passages with ethmoid plates. In one petiole, 380 air-ways were counted. The flower bearing stem, like that of the *Pontederia* has a large central passage in which the partitions are from 6 to 30 mm. apart. Around this central cavity the smaller air-ways are quite as numerous as in the *Ponte-*

deria. There are two forms of petioles, the one short and inflated, the other tapering from the base upwards without special enlargement and reaching sometimes a length of 67 centimetres. Both may occasionally be found on the same plant. The rhizomes and runners by means of which this plant multiplies so rapidly, have a central solid part and, around this, numerous air-ways without diaphragms.

Fig. 9 shows an inflated petiole a fourth the actual size. Figs. 10, 11, 12, 13 give half the real size of successive sections of a tapering one that was 26 c. m. long, 10 being taken at the base and the others at the respective heights of 7.6, 15, and 23 c. m. The diaphragms in *Eichhornia* are like fig. 3, but the apertures are much smaller.

The *Sagittaria variabilis* of the Northern States and *S. lancifolia* of the South have diaphragms of a somewhat different type, the branches of the cells being much more numerous and many of the perforations having a long oval form. One of these plates is represented in fig. 14, enlarged 150 times. It will be observed that of the lines formed by the joining of the cell branches only two abut on each of the oval openings. Fig. 15 shows half the size of a petiole in cross section, taken half way up, in which were counted over 400 air-passages.

The flower-bearing stem of these plants has no large central hollow. In the sheathing petioles of the little *Alisma plantago*, which is of the same natural order as *Sagittaria*, the ethmoids are of an intermediate character, the cells having from six to twelve branches and there being only occasionally an oval aperture between the triangular ones. The flower-bearing stem is hollow and there are some ethmoids in the large cavity.

Of a still different type are the horizontal partitions in the leaves of *Typha latifolia*. Here they are made up of very slender, branching cells and the apertures are relatively large and very irregular in form. These aper-

tures have more commonly four or even five cell joints abutting on them, instead of three. In most of the air-passages there may be found two or more very fine fibre bundles running down through the plates. Excepting these, the spaces between the plates are empty in the upper part of the leaves. But in the lower and sheathing part, the chambers are filled with slender cells branching in every direction, like those in the pith of *Juncus effusus*. The term "stellate" as applied to the *Juncus* cells,* and the figures shown in some of the books are far from giving a correct idea of the actual form. Sections made horizontally, vertically, or obliquely have about the same appearance. Hence the cell branches are quaquaversal instead of being in one plane, and they are quite irregular. This tissue resembles the texture of fine commercial sponge as seen under the microscope. It is spongioid.

The flower-bearing stem of *Typha* is solid. Fig. 16 gives a transverse section of a *Typha* leaf, of the real size.

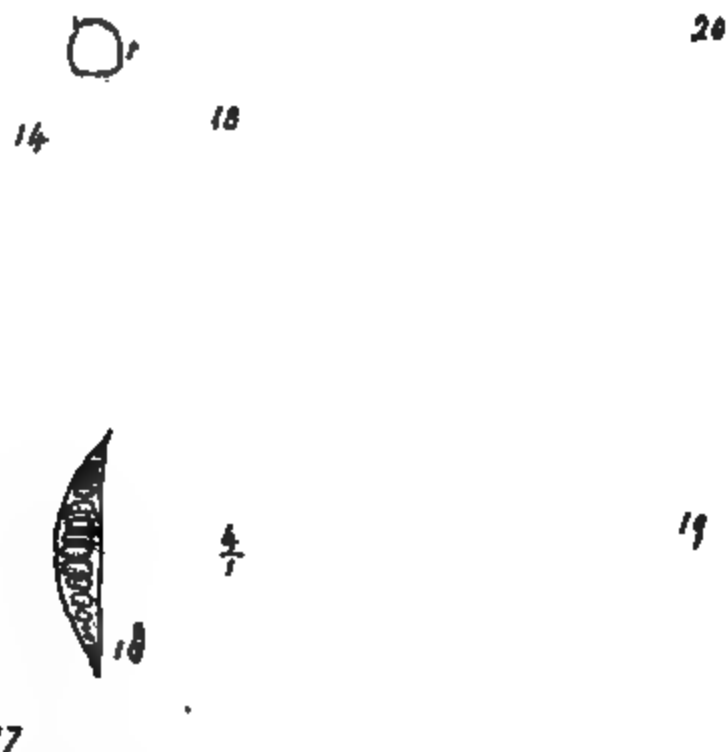
Fig. 17 represents a portion of one of the diaphragms magnified 55 times. Fig. 18 shows a longitudinal of some upper air-passages of about twice the natural size, with fibre bundles running through the chambers. In planes further back other fibres would be seen. They appear as dots in fig. 16.

Diaphragms of a fourth type are found in the petioles, scapes, and spadix of *Peltandra undulata*. In this case the cell division lines run between the angles of the apertures instead of the sides; and so the cells are polygonal and not branching. As this plant is pervaded by a colorless jelly insoluble in water, slices are somewhat difficult to handle. But the slime may be removed by soaking three or four hours in weak ammonia water and then washing with clear water.

*In Engler's new "Das Pflanzenreich" these cells are called "Parenchymstrangen" and the diaphragms "Parenchymrippen," neither of which designations is particularly apt.

Fig. 19 represents a small portion of the *Peltandra* petiole in cross section. Fig. 20 is a view of one of the diaphragms enlarged 75 times. The cells show numerous grains of starch or chlorophyll. *Richardia africana* has the same structure as the *Peltandra*.

The sheathing petioles of *Canna indica* have about 25 air-passages arranged like those of the *Musa*. The diaphragms are from three to six millimetres apart and are thickish and somewhat obliquely placed. The intermedi-



ate chambers are filled with spongioid tissue, and this grows in close contact with the partitions so that it is very difficult to isolate them for examination. The diaphragms themselves are of the *Peltandra* type.

Some of the coarse grasses, like *Zizania*, have sheaths furnished like the *Canna*. Some have diaphragms without intermediate tissue.

The leaves of *Acorus calamus* and the petioles of *Symplocarpus fetidus* have very numerous air-passages with ethmoid diaphragms. Very good examples have been

met within the leaves of some other plants, which however had no flowers or fruit to give a clue to their names. But one of these deserves special mention because the diaphragms are so different from those heretofore described. It is a rush-like plant, probably a *Triglochin*, with very narrow leaves about a foot long and oval in cross section. Here the cell joints are swelled so that, at first sight, they appear like interposed globular cells. The apertures are therefore triangles each of whose sides has a curved indentation.

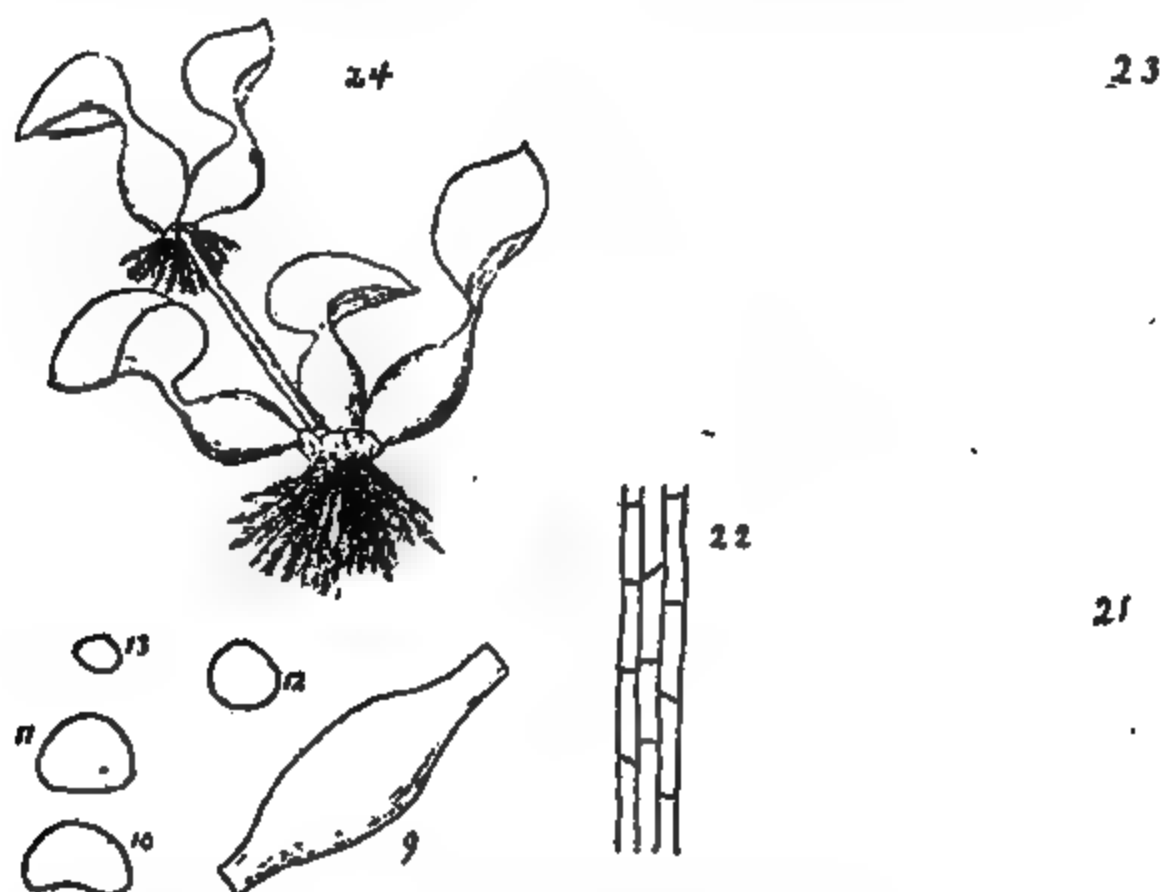


Fig. 21 is a cross section, enlarged 18 times. Fig. 22 shows some of the air-passages and diaphragms on a scale of 7 to 1. Fig. 23 represents part of a partition magnified 175 times. But as this last was not drawn directly from the object, it is a little too regular.

It is evident that in the structure of organs with large air-chambers and ethmoid partitions, considerable firmness is secured with a minimum of solid material. At the same time the free circulation of air in all parts con-

tributes to rapid growth. A banana petiole cut off at the base of the leaf and 42 c m. farther down was found to displace 239 c. c. of water and to weigh 57.5 grams. The net specific gravity was 1.085. Hence there were only 53 c. c. of vegetable matter and sap to 186 c. c. of air. The weight after drying was 5.04 grams. So we have about 1 measure of solid matter to 10 of water and 186 of air. This petiole sustained a leaf weighing 192 grams.

But for lightness the swelled petiole of the *Eichornia* must bear the palm. The one shown in fig. 9, of quarter size, measured 50 c.c. and weighed 4.4 grams. Air-dried, it weighed 0.334 grams. So 11-12 of the bulk was air, and 1-13 of the weight was solid matter.

Air-spaces with diaphragms seem to have some connection with the parallel veining of the leaves. In the leaves of *Iris versicolor* the partitions are not perforated. I have not yet found diaphragms in any dicotyledonous plant. There are four large air-ways in *Nymphaea odorata* and many more in *Nuphar advena*, but here the remarkable, stout, many pointed, distinct cells may act like skewers to keep the parts in place and yet do not interfere with the flexibility. In *Nelumbo lutea* the same office appears to be performed by adherent clumps of calcium oxalate crystals which are purposely distributed along the inner walls of the four large air-passages.

H. S. Newcomb M. College, New Orleans, Oct. 31, 1901.

Catalogues of Microscopes, etc. can be had from ———
R. & J. Beck, Ltd., 68 Cornhill, London.

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W. Watson & Sons, 313 High Holborn, London, W. C.
England.

The Fungi.

GEO. F MASSEY, F. L. S.

Next to the Phanerogams, or the flowering plants, the Fungi constitute the most extensive group of plants known. Just over 50,000 species are already described, and every year this number is being augmented. In Great Britain are 5,000 species of Fungi, which far exceeds in number that of all other groups of native plants—Phanerogams, Filices, Muscinae, Algae, Lichens—added together.

As in every division of the animal and vegetable kingdoms, the primary groups are indicated by one or two prominent morphological features, which are supposed to indicate a common origin, whereas other and unimportant or secondary characters presented by the group are often very varied. In the Agaricineae, a family including some thousands of species, the common bond of union is the presence of gills or thin plates bearing the spores or reproductive bodies on their sides. The members of this group are popularly known as toadstools, with the exception of the edible species of our pastures, which are dignified by the name of mushroom. The mushroom-eating public flatter themselves that the only fungus they eat is the true mushroom (*Agaricus campestris*). This, however, is far from being the case. *A. campestris* pure and simple is rarely if ever grown by cultivators, but in its place a variety of this species with a brownish more or less scaly cap, known scientifically as the variety *hortensis*. The horse mushroom (*A. arvensis*) is often sold in the London markets as the true mushroom. However, all these are edible, even if lacking in taste and aroma. In this instance "ignorance is bliss."

The uses of Fungi are various. As food products, owing to fear of poisoning, with the exception of the kinds mentioned above, the numerous edible varieties are mostly ignored, except by mycologists. The fungus popu-

larly known as "bluewits" or "bluecaps," however, is often offered for sale. We have at least eighty different kinds of fungi perfectly safe and good to eat. Of these, forty kinds are common and widely distributed, the most abundant and one of the best being the "parasol mushroom" (*Lepiota procera*), one of the toadstool type, having a slender stem five to eight inches in length, and a flat brownish scaly cap six to nine inches across. The gills are persistently white.

The Morels, as they are called (*Morchella*) are amongst the best of edible fungi, and belong to a group of fungi that appear in the spring, when other kinds of edible fungi are absent. The species grow on the ground among grass, the stem is stout, and the cap or spore-bearing portion is globose or conical and marked on the outside with deep irregular depressions. In the Southern Hemisphere the counterparts of our Morels are parasites growing on trees.

There is only one genus (*Cyttaria*), and the species, so far as is known, only grow on the different species of evergreen beech. These southern Morels are not uncommon in Chili and in Tasmania, and were in both countries eaten by the aborigines, as they are at present by their successors. Several species of fungi are eaten by squirrels. Slugs and snails are also partial to some kinds, the poisonous species of *Russula* being especial favorites.

Poisonous fungi do undoubtedly exist, but among the kinds that are at all likely to be collected for food poisonous kinds are not so common as generally supposed. Probably 90 per cent of the deaths caused by poisonous fungi, are due to eating the "death-cup" (*Amanita phalloides*), or its near relation *A. mappa*. Why these fungi should be collected for food is not quite clear. They certainly do not in the least resemble any species usually considered as good for eating—least of all the common mushroom; perhaps it is on account of their neat appearance,

and the absence of anything suspicious in the way of smell or taste that they tempt the uninitiated.

In the majority of fungi the spores are diffused by the wind, but in the most highly organized group (*Phalloideae*) the spores are distributed by insects, which, curiously enough, are attracted by color, scent, and nectar-like food, exactly as in the case of those flowering plants where cross-fertilization is effected by insects. The Phalloideae are most abundant in tropical regions. In Britain the group is represented by three species, two of which—the large stinkhorn (*Phallus impudicus*) and the smaller stinkhorn (*Mutinus caninus*)—are fairly common throughout the country, whereas the third, the latticed fungus (*Clathrus cancellatus*) is only met with on rare occasions in two or three southern counties. The smell in all species is very penetrating, and from the ordinary human standpoint intensely disgusting, although not objected to by flies and other insects, which pick up the scent and gravitate in great numbers towards its source, where they find a greenish dripping gluten, very sweet to the taste and containing the exceedingly minute spores imbedded in its substance. This mucus along with the contained spores is greedily eaten by the flies, and by this means the spores are distributed far and wide. In the most highly organized members of the Phalloideae, very varied and beautiful contrivances are present, serving as a platform for insects while partaking of their feast. These platforms are so arranged that the sweet mucus, trickling from the cap where it is produced, flows over their entire surface, thus affording standing room for more insects than if the mucus remained on the comparatively small cap.

In one species (*Dictyophora daemonum*) the fungus has a stout erect stalk four or five inches long, bearing at its tip the mucus and spore-producing cap. Springing from the stem just below the cap is a very beautiful network-

structure fashioned like a lady's skirt or rather a crinoline which widens out downwards and reaches almost to the ground. Onto this crinoline the mucus spreads in every direction. In our latticed fungus the portion smeared with mucus is bright red, and resembles a hollow globe having a wall of network, the globe being about three inches in diameter. In other kinds variously branched coral-like appendages receive the mucus.

The subject of parasitic fungi is so extensive that an extended series of talks would be necessary to make clear even the broad outlines of the study, which embraces members belonging to every family of fungi, the individuals varying in size from the ephemeral microscopic mildews and rusts to the large woody structures, resembling inverted brackets, which grow upon and destroy forest trees. The following figures will give some idea of the enormous amount of injury done to the higher plants by parasitic fungi.

In Prussia, according to the Statistics Bureau, the loss on the crop of wheat, rye, and oats, caused by fungi during the year 1891, amounted to \$100,000,000, almost a third of the total value of the crops. In Australia the loss on the wheat harvest of 1890-'91 due to rust was estimated at \$12,500,000. In the United States the vineyards have suffered terribly from the fungus pests. Up to the present time 30,000 acres of vines have been destroyed, causing a direct and indirect loss of 20,000,000 dollars.

These are not exceptional cases, but average illustrations of the disastrous effects produced by parasitic fungi on cultivated crops. Until quite recently these epidemics were accepted with calm resignation, being considered as deserved visitations for wrong-doing. At the present day most civilized countries are establishing experiment stations for the purpose of studying these pests and devising means for checking their devastations.—*Quekett Club*.

Extracts from Postal Microscopical Society's Note-books.

Edited for Science Gossip.

Eristalis Tenax, Longitudinal Section of Halter.—For convenience of examination the halter of the fly may be divided into three separate parts, viz. base, pedicle, and globe or head. On the exterior surface of the base there are three distinct areas or sets of sense organs which have severally an anterior, posterior, and lateral aspect. These have long been considered special sense organs. The lower area is somewhat rounded on the face, and covered with delicate elevations of the epidermis which take the form of circular papillae. They are divided into rows, and between each row there is a line of curved hairs. Lowne states that there are two distinct sets of these lower organs, and Theobald in his work on the "British Flies" has repeated this statement; but in no instance have I met with more than one, and it has invariably a lateral aspect. The two upper organs are placed on opposite sides of the halter, one anterior and the other posterior. They are much longer and larger than the lower one, but like it in having rows of ridges beset with papillae separated by fine hairs. Several sections show the lining epithelium remarkably well. In this place it is especially modified to form a sensory or nerve epithelium. The pointed ends of the cells are seen penetrating the papillae of the lateral organ. The halters receive their rich supply of nerves direct from the second thoracic ganglia. This pair of nerves is the largest in the thorax, and crosses to the opposite side immediately on entering the ganglia. The pedicle is a hollow tube connecting the base of the halter with the globe. On the external surface it is covered with hairs. The interior is divided by a septum which is continued the whole length. A large tracheal vessel passes through it to the globe, where it breaks up into many branches which ramify in the tissue.

Sarcophaga Carnaria, Longitudinal Section of Halter.—

These sections show the vascular tissue in the so-called globe of the halter. In all the halteres I have examined the deep invagination seen in these sections of the globe is invariably present, and there is always a mass of connective tissue extending from the invaginated wall to the opposite wall of the globe. The purpose of the invagination is unknown to me, unless by some means it allows of a certain amount of expansion and contraction of the globe. The large glands most probably secrete a fluid necessary for organs at the base of the halter. The halteres of Diptera doubtless assist in their locomotion, but the evidence of their elaborate structure proves that they have another most important function. The positions of the papillæ are such as to present a front in every direction, and their structure is so delicate as to permit of vibration when sound-waves or other unusual movements of the air impinge upon them. Also the nerve epithelium bathed in fluid secreted in the globe, together with the very rich nerve supply, point to their being rudimentary nerve organs. Otoliths, so commonly found in the Crustacea and Mollusca, I have not met with here, but that does not prove their non-existence. The great number of papillæ (400 to 500) in each halter, and the small number of olfactory organs (two in each antenna) found in many flies which feed on the nectar of flowers, compared with *M. vomitoria* and *M. domestica*, whose halteres carry half the number of papillæ, and in whom the olfactory sense is highly developed, show that the former possess an acute sense to warn them of danger when their heads are buried in the blossoms of the plants they frequent, and that the latter have comparatively little use for such a sense.

Anterior Thoracic Spiracle of Blow-fly.—This spiracle is oval and narrowest above, and is situated between the

pro- and meso-thorax. From the exterior free edge project hollow arborescent chitinous rods, which curve upwards and interlock for about one-third of the length of the spiracle. These rods are hollow, even to the minutest twigs, which have a free opening at their points. Close behind is a transparent membrane, the true valve. It is united to the wall of the large tracheal vessel which extends across the thorax to the opposite spiracle. The free edge of the valve is closely set with a chitinous fringe. A special muscle arises from the integument at the lower end of the spiracle. By the contraction of this muscle the free edges of the valve would be caused to approach each other. From the integument another set of muscles arises, which are directed towards the valve, but whether they are connected with it I have not been able to determine. Antagonistic muscles are a necessary consequence for working the valve.

PROBOSCIS OF BUTTERFLY.—The tongue, or proboscis, is a cartilaginous substance, and owes its great flexibility to being formed in rings, which give it a finely-engraved appearance under the microscope. It is formed of two pieces that can be separated through its whole length, and each being grooved on the inner side they fit together perfectly air-tight; this is effected by an infinite number of fillets resembling the laminæ of a feather which interlace and adhere to each other. Between this groove and the outer skin is a space occupied by tracheæ or the breathing tubes. The proboscis is always carried coiled, but can be uncoiled in a moment. It is perfectly suited to the work of penetrating to the honey of flowers. We know how butterflies close their wings as they alight on a flower, when the insect makes a powerful expiratory effort by which the air is expelled from all tracheæ. At the moment of applying its proboscis to the food it makes an inspiratory effort by which the tube of the proboscis

is dilated and the food ascends at the same moment to fill the vacuum produced, thus passing to the mouth and stomach, being further assisted thereto by the muscles of the proboscis.—*Mrs. W. Major.*

The function ascribed above to the tracheæ is a novel one, and it is difficult to understand how a vacuum can be produced in the œsophagus and its connections by driving the air out of them, even if it were possible. In insects the mouth can only be considered as connected with respiration in the most indirect manner, if at all; for although in certain acari the air-tubes open at the base of the mouth, there seems to be nothing analogous in insects. Respiration in insects is effected by means of two large canals, called "tracheæ," running along the sides of the body underneath the outer surface, which communicate with the air by short tubes called spiracles situate along the sides. I take it that these tubes can never be exhausted of the air they contain, seeing the walls are supported by spirally convoluted fibres, which impart great strength and prevent collapse; and that the air is changed within them, according to the necessity of the creature, by the closing or opening of the spiracles and the continuous rhythmic movement of the body. It may be well to say a few words with respect to the means by which in the Proboscidea the food is drawn up into the stomach. The Hymenoptera, the Lepidoptera, and Diptera are provided with a bladder-shaped distension of the œsophagus which would appear to be a modification of the crop, and is called a "sucking stomach." This is not a receptacle for food, but by its distension and the consequent rarefaction of the air contained therein it promotes suction of the same and facilitates the rising of fluids in the proboscis and the œsophagus, and it is by this means these insects rifle the flowers of their contents.—*E. Bostock.*

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

AND H. A. HAIG.

COLORING OF WATER BY MICRO-ORGANISMS.—Much curiosity and speculation have been aroused in the neighborhood of Stoke Bridge, Ipswich, by the turbidity and deep chocolate color of the river Orwell, reaching for some little distance from each side of the bridge. This appearance has been ascribed by some to the scourings of the maltings, by others to spawn, also to the sun, or to the remains of star and jelly fish. This remarkable coloration of the river is in streaks of a greater or less width, and extends but a few inches beneath the surface, whilst on the decline of the sun the color wholly disappears. This phenomenon is caused by countless myriads of beautifully marked plants of a deep chocolate shade. This coloring matter can readily be discharged by chemical reagents and the green structure of the plant rendered apparent, or by the action of iodine the presence of starch can readily be determined. These plants bear a striking similarity in their movements and power of contractility to the fresh water *Euglena*, but in form they resemble a bicuspid tooth, with a deep cleft on each side of the axis. The two fangs might be taken to represent the head, and the crown the base; each plant being about the 1-3,000th of an inch in diameter. Some hundreds of these organisms may be seen gaily disporting themselves in a drop of water scarcely exceeding in size a pin's head, the whole being in a rapid state of motion. These brackish water organisms are delicate, breaking up a few hours after being removed from their habitat. The plants appear to come up with the tide, and are not due to the presence of sewage or other preventable matter.—*Alfred Martinelli, Ipswich.*

BRACT AND FRUIT-SCALE IN CONIFERAE.—The carpellary-

scale in *Pinus*, or *Larix*, corresponds, as is well known, with a carpel in the Angiosperms, but differs in that it is not folded on itself, but is dorsi-ventrally flattened, and bears the ovules upon its upper surface. The bract is a scale-leaf, in the axil, and perhaps partly from the upper surface, of which the fruit-scale arises. The relative arrangement of the xylem and phloem in these two structures is peculiar, and has a distinct physiological bearing upon the question. In the fruit-scale we find that the phloem is uppermost, and adjacent to the under surface of the ovule, whilst the xylem is underneath. In the bract, on the other hand, the xylem is uppermost, lying adjacent to the under surface of the fruit-scale, the phloem being underneath. In this structure, then, the constituents of the bundle have the same relative position as in an ordinary bifacial leaf, whereas in the fruit-scale they have received a "twist," whereby phloem is brought uppermost. That the phloem should lie next the ovules is of importance, for the elements of this tissue merge gradually into those of the nucellus and seed-coat, and there is thus every facility for rapid diffusion of food material during the process of reproduction. Various views are held concerning the manner in which the altered relative position of xylem and phloem is brought about, but these need not be here discussed.

THE STRUCTURE OF THE NUCLEOLUS.—The "definitive" nucleus of *Caltha palustris* offers many interesting points for observation. In the first place, its large size, relatively to the dimensions of the embryo-sac, renders great aid to investigation, as also does the comparative ease with which sections may be made of the sac in the ovules. A longitudinal section of an ovule of *Caltha* at a certain stage prior to fertilization will, if the section be successful and carefully stained with hæmatoxylin, safranin, and toluidin blue, show us all the structures contained in

the embryo-sac. These are (a) the "definitive nucleus," (b) the "synergidæ" and egg-cell at the micropylar end of the sac, and (c) the "antipodal cells," three in number, at the opposite end. In the definitive nucleus we easily make out the nuclear membrane, the chromatin masses, and the large nucleolus. The latter has a well-defined border, and moreover this border is seen to be of fair thickness, and may at certain points be depressed towards the interior, which is clearer. Obviously in this case the nucleolus has the structure of a vesicle, and it is probable that all nucleoli are of this nature, being filled with a clear fluid of an oily consistency.—*Science-Gossip*.

THERMAL DEATH-POINTS OF BACTERIA.—Different species of bacteria vary greatly in their powers of resisting the action of heat. Speaking generally, pathogenic micro-organisms perish at a much lower temperature than non-pathogenic bacteria. Thus the well-known *B. prodigiosus*, which forms a beautiful blood-red colony when grown on moist bread, cannot withstand a temperature of 58° C. for more than ten minutes, whereas the tetanus bacillus only perishes after six hours at 80° C. The bacillus of tuberculosis is rapidly destroyed in cultivations at 70° to 80° C.; but according to Welch, it can resist in the dry state a temperature of 100° C. for three hours. In milk it has been found to perish after four hours at 55° C.; one hour, at 60° C.; five minutes, at 80° C.; and one minute, at 95° C. (Forster). The spores of bacteria can withstand far higher temperatures than the bacteria themselves. Thus the spores of the tetanus and anthrax bacilli are both extremely resistant to heat, though the latter are destroyed by moist heat at 90° to 95° C. This fact is recognized in the sterilization of food products, which are first heated to a sufficient temperature to destroy the parent bacteria, then left for the spores to develop, and again heated to kill the newly-formed bacteria.

As regards the action of heat upon the toxic products of different bacteria, it has been found that some, like the toxin of tetanus, are decomposed and rendered harmless after a short exposure to a comparatively low temperature; whilst others, like the toxine of anthrax, are only weakened and not destroyed at the temperature of boiling water.

MICROSCOPICAL SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.—

October 6, C. Baker exhibited a portable microscope on the model of the "Diagnostic" originally designed for Major Ronald Ross's investigation of malaria. It was made of magnalium, an alloy of manganese and aluminium, and weighs but 14oz. He also exhibited a microscope intended for the examination of fractures and etched surfaces of metals. It is provided with vertical illuminator, rack-and-pinion focussing adjustment and leveling-screws to the mechanical stage, now usual in this class of instrument. Messrs. R. and J. Beck exhibited a portable model of their London microscope, which was a very substantial instrument, and was, by the introduction of several ingenious devices, made to pack with the apparatus into a leather case 2½in. by 4½in. by 9½in. Messrs. Beck also exhibited a centrifuge, made to run at high speed by an electric current. The president brought to the meeting some specimens of the mycetozoa, and gave a brief account of the life-history of this group of organisms. The specimens belonged to a recently-described species, and had been named *Badhamia folucola*, and he had brought some leaves and grass on which were spores for distribution. Mr. C. L. Curties, exhibited a number of mounted specimens of marine zoological objects, accompanied by very full and interesting descriptions. The president gave a *resume* of a paper by Miss A. Lorrain Smith, "On Fungi

found on Germinating Farm Seeds." Miss Smith had been assisting him in his work for the Royal Agricultural Society in examining farm seeds in respect to their germinating power. In the course of their observations, Miss Smith had found numerous species of fungi on the germinating seeds, 14 species in all, of which five were new and one belonged to a new genus. Mr. Millett's report on the foraminifera of the Malay Archipelago, was taken as read. Hon. Thos. Kirkman sent some of the fine quills of the porcupine for distribution among the Fellows, who would find them very useful in mounting minute objects.

DEFUNCT.—Professor C. E. Bessey of the University of Nebraska informs us that the Lincoln Microscopical Club has ceased to hold meetings and that there is no prospect of resuming. If we had the right kind of a National Society which conferred Fellowships upon presidents of local societies, it would be easy to keep these little feeders at work.

NEW PUBLICATIONS.

GAGE'S INTRODUCTION TO MICROSCOPIC METHODS AND HISTOLOGY.

In 1901, the eighth edition of this handbook has been issued. It has now reached 300 pages and 230 figures. This brings it along up towards the size and importance of the first edition of Carpenter. It clearly stands at the head of American works of its class. Indeed we know of nothing to compare with it. Presumably it is primarily a reference and laboratory work for Professor Gage's own students at Cornell. Doubtless it is used as well in the histological classes of many other American colleges. But one can fairly ask why this ground was not long ago taken up by some one at Yale, Harvard or Columbia. Since Gage began, perhaps a dozen years

ago, he has constantly worked up new material and the frequency of editions suggests that the type must be kept standing in Ithaca and a fresh set of proofs sent up the hill very frequently for emendation and expansion. This thrift is very commendable in a constantly changing and growing field of learning. Unfortunately, the old editions quickly outlaw and second-hand copies are worthless.

Comparison with Carpenter is hardly to be thought of, and yet having searched Carpenter's very latest edition for a description of the ever-mentioned "Society Screw," in vain, we turn to page 64 of Gage's Manual and find the formula exactly and properly quoted.

For the general microscopist, we conceive that Carpenter answers every purpose and is indispensable. But for students the price is important. Carpenter costs \$8.00 and Gage perhaps \$1.50. Its data is all easily available through a complete and skillful index.

The frontispiece shows the names of all the 17 parts of a microscope in such a way as to immediately inform a beginner of what the instrument is composed. The other 228 cuts are equally clear and instructive. A dozen or more instruments of different make are shown including both domestic and the better foreign ones. We shall refer later to other matter contained in the book.

MISCELLANEOUS.

ASPLANCHNA.—Several species have interesting jaws and teeth. The jaws are dissolved out with caustic potash and mounted separately. The jaws are from 100 to 150 microns long, (25,000 microns make one inch).

LIQUID AMBER.—Liquid amber *styraciflua* is spoken of as *storax*, *balsamium styracis*, *styrax liquidée* and *Flussiger storax*. It has a high refractive quality. It is used

for mounting diatoms. It always contains a little water which gives it a grayish opacity. This, removed by long standing or heat, it becomes quite transparent. When so dried, it is soluble in alcohol, benzole, chloroform, ether, carbon bisulphide, and volatile oils but not in petroleum ether. When not thus soluble, try xylol and impart a little heat to it. Neither Carpenter or Gage have alluded to it.

STORM EFFECTS.—Maj. H. A. Cummings while in South Africa studied the storms of the Pretoria valley. The air becomes very heated and dry. Storms of severity occurred including whirlwinds of dust, paper, leaves, etc. A nutrient gelatin plate exposed one second in one of these storms developed thousands of colonies of bacteria. The people believed that fever was spread thereby. We may in this way see the power of wind to devastate whole areas of tropical territory.

VACCINATION.—In view of such facts as the following, it is very difficult to see how the persons who are crying down vaccination are actuated by anything less than very blind prejudice.

Jenner's discovery was made in 1798. Prior thereto the ravages of small-pox were simply astonishing, one fourteenth of the population of the earth dying therefrom. In a single year of epidemic in Russia, 2,000,000 persons died of it while many more were made blind or otherwise disfigured. The average annual death-rate in all of Europe was 210,000 by small-pox alone. In Great Britian, the deaths were 40,000 in 1798 but immediately upon vaccination being commenced the deaths decreased to 6,000. In Venezuela, in 1812, Balmi exterminated the disease there; in 1813, a million of people were saved in South America by vaccination. Before Jenner's day, great epidemics of small-pox swept off people like so many flies; since, there have been no epidemics and the uni-

versality of vaccination has rendered it impossible to see what would occur without it.

That rare and occasional accidents have accompanied vaccination may possibly be true. But he who objects on this account is like the man whose store being on fire would not permit water to be thrown in lest some of the goods should get wet!

CARBORUNDUM.—This is silicate of carbon manufactured at the Falls of Niagara by heat produced by a powerful electric current. A wall about 14ft. long, 7ft. broad and 7ft. high, is built up of nuts of coke, faced outside with loose bricks. Along the centre of the wall runs a core composed of ground coke, mixed with sand, salt, and sawdust. A current passed through the core soon heats it up, and burns the sawdust, which leaves the core porous. Next the salt is decomposed, the chlorine in it finding its way to the outside, the sodium remaining behind and uniting with the sand. As the heat increases, the sodium comes off also in a state of vapor, leaving behind the silica of the sand in a state ready to unite with the carbon of the coke. The union produces carborundum in crystals. After long cooling, the wall is thrown down, and the carborundum is extracted. The name is hybrid between carbon and corundum, which has nothing to do with the substance further than that it is half a grade higher than it is in hardness, being inferior only to diamond. It is largely used for polishing granite instead of emery. When pounded and mixed with clay, made into small bricks, and discs, and fired in a kiln, it makes hones of great abrasive power, and wheels which grind down axles or cut through rods of iron.

For Sale.— A Beck stand with three lenses, very little used. Price \$10. Address: G. W. Wilcox, care this office.

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The Ehippium of Bosmina.

D. J. SCOURFIELD.

ILLUSTRATED.

The production of winter or resting eggs in the genus *Bosmina* has been referred to by various writers on the Entomostraca, but I do not think that any description of the egg's protective covering, which corresponds, of course, to the ehippium of the *Daphnidæ*, has hitherto been published. As this structure exhibits one feature at least which distinguishes it from the homologous productions of all other forms of the Cladocera, it appears worth while to bring forward the present short paper on the subject.

If we examine the recently thrown-off resting eggs of *Bosmina longirostris* enclosed in its protecting case (fig.

1), we shall see at once that the latter is only a portion of the carapace of the mother. The particular part of the shell which has been utilized for the purpose evidently consists of the valves (as distinguished from the head-shield), with the exception of a rather large piece of their ventral margins. The ventral margins have not wholly disappeared, for the characteristic shell-spines at the posterior ventral angle are still present. At first sight it does not seem that the portion of the shell now enclosing the resting egg has been specially modified. The ordinary faint hexagonal markings on the surface of the valves are quite apparent, and the valves themselves are as transparent as when forming part of the coat of the living animal. Towards the back there is, it is true, a somewhat darker tinge than usual, but this is not very noticeable, and taken by itself would scarcely suggest special modification. Looking more closely at the structure, however, it will be seen that at the back—*i. e.*, along the line representing the dorsal margin of the original valves, there is a distinct increase in the thickness of the chitin, and, further, that there is a narrow, highly refractive band of chitin running somewhat obliquely across each valve from near the anterior dorsal angle to within a short distance of the posterior margin. It is the possession of these lateral thickened bands of chitin which distinguishes the ephippium of *Bosmina* from all homologous structures.

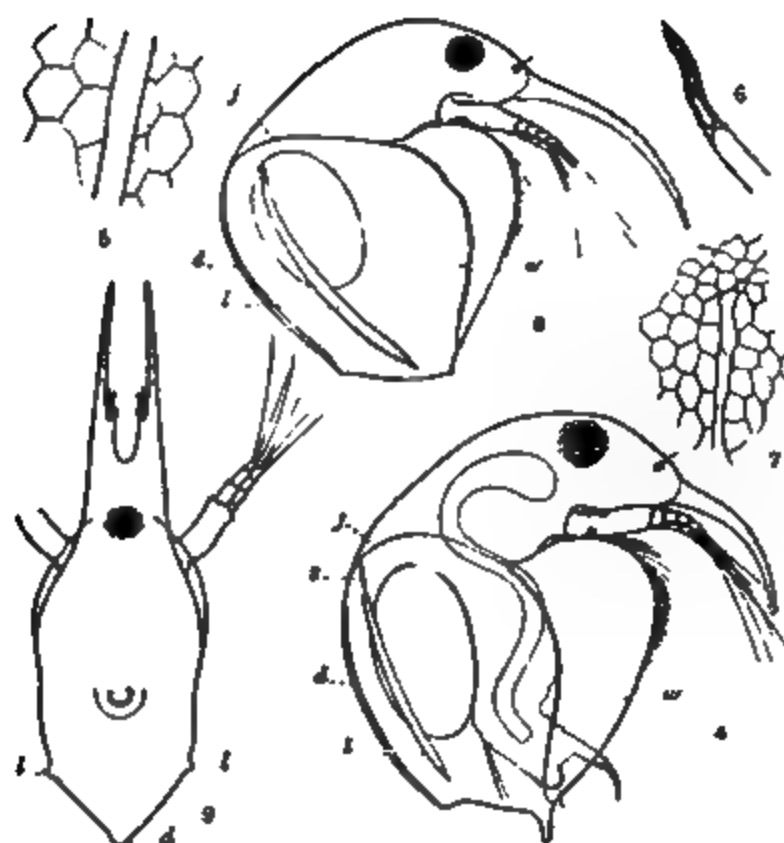
If one of the lateral bands of chitin be still further examined, it will be seen that it probably represents a modified line of hexagonal areas, forming part of the shell sculpture of the unaltered valve. But all the cross partitions have been obliterated, and the edges of the band have been smoothed so as to show but little indication of the original polygonal arrangement. The extremely minute granulation or pitting of the areas enclosed by the shell markings has also disappeared, for the chitin

of the band seems absolutely homogeneous (fig. 5). In continuation of the band anteriorly, there is a slit in the valve which runs up to the anterior margin near the anterior dorsal angle. The edges of this slit are normally in contact, but may be easily separated by pressure. The slit seems to be produced by the falling out of a number of pieces of chitin (fig. 6), exactly in the same way as I have described in the case of the line of separation along the ventral edge of the ephippium and round the valve margins in *Leydigia acanthocercoides*. The pieces of chitin no doubt represent modified hexagonal areas of the original shell sculpture in the same line as the series which produce the lateral band. In connection with this it may be pointed out that the anterior end is often seen to be separated from the rest of the band by a transverse line (fig. 1). At its posterior end the lateral chitinous band appears to end abruptly in the ordinary shell markings.

In *Bosmina longirostris* the lateral bands do not project very much beyond the surface of the shell, but in a species (fig. 8) from Upper Lough Erne (probably *Bosmina lilljeborgi* Sars, although this is perhaps only a variety of *B. coregoni* Baird), very kindly sent to me by Mr. W. F. de V. Kane, the projection of the lateral bands is so pronounced that they deserve to be termed ridges (fig. 9). The position of the bands in this case is also a little different to what it is in *B. longirostris*. As will be seen by a comparison of fig. 8 with fig 1 and 4, there is a rather greater distance between the lateral bands and the back of the shell in *B. lilljeborgi*(?) than there is in *B. longirostris*; and more important still, the lower ends of bands approach very much nearer to the posterior ventral angle of the shell in the former than in the latter species. I may mention here that the lateral bands are not always so evenly curved as shown in the figures, but that they sometimes exhibit rather abrupt bends—as if in

their formation the deposition of chitin had not followed one line of cells the whole way, but had changed from one series to another.

As regards the function of the lateral bands, I would suggest that, in addition to strengthening the ephippium



as they evidently do from their position almost directly over the egg, they may also help to keep the free edges of the valves more closely in contact than might otherwise be the case. Such a result would certainly follow if the ends of the bands, by their elasticity, possessed the power of pressing inwards and carrying the free margins

of the valves with them. I do not know whether such a tendency exists, but it is at least very probable.

In addition to having the lateral bands very strongly marked, *B. lilljeborgi*(?) also shows the thickening along the back as a distinct ridge (fig. 9). That the dorsal thickening is really in the form of a sharply defined band can however, be also seen in *B. longirostris*, when views can be obtained either from the front (fig. 3) or back (fig. 2).

There is still one other point requiring elucidation, namely, how is it that the ventral portions of the valves become detached when the shell is to form an ephippium? By very careful scrutiny of a female carrying an ephippium and winter egg (figs. 4 and 8). It can be demonstrated that there is a line of weakness, marked by a faint doubly-contoured line on each valve already formed in the exact position where the anterior portion will break away. This line of weakness can be developed into a crack, at least for some portion of its length from the anterior end, by applying pressure. The edges of the crack are quite smooth. The line of weakness does not cross any of the

EXPLANATION OF PLATE.

Fig. 1. Ephippium of *Bosmina longirostris*, side view $\times 150$; Fig. 2, dorsal view $\times 140$; Fig. 3. front view (somewhat flattened out of shape), $\times 140$.

Fig. 4. *Bosmina longirostris*, carrying ephippium and winter egg, $\times 130$.

Fig. 5. A portion of a lateral band of chitin, with adjacent shell-markings (ephippium of *B. longirostris*), showing how the areas enclosed by the latter are pitted, whilst the band is structureless, $\times 350$.

Fig. 6. Upper portion of a lateral band (*B. longirostris*), showing the loose pieces of chitin at its anterior end, which apparently fall away and produce the slit found in this position in the ephippium, $\times 280$.

Fig. 7. Portion of shell culture of a specimen of *B. longirostris*, showing probable early stage in the formation of the line of weakness between the ephippium and the ventral portions of the valves, $\times 180$.

Fig. 8. *Bosmina lilljeborgi* (?), carrying ephippium and winter egg, $\times 90$.

Fig. 9. *B. lilljeborgi* (?) view from above, showing the projecting lateral and dorsal bands of chitin, $\times 110$.

ordinary shell markings on the valve, but, from the relation of the latter to one another on each side of the line it is evident that a considerable amount of alteration of the original shell sculpture has taken place. The probability is that a line of hexagons has been suppressed or rather completely modified to form the line of weakness, and this view is borne out by the arrangement of the shell markings shown in fig. 7, where we seem to have a very early stage of the process exhibited. The one long cell, which lies exactly where a portion of the line of weakness is always developed, has plainly been formed from the ordinary hexagonal markings, because its edges show the characteristic zigzag arrangement, and the crossbars are also just discernible, although almost obliterated. It is somewhat strange that in the specimen from which this was drawn there was no trace of any modification having commenced for the production of the lateral bands and slits. It looks as if the production of a line of weakness may be older in the history of the development of these ephippia than the formation of the lateral chitinous bands. This may very well be so, because among the Lynceidæ, where there is in many cases scarcely any actual modification of the shell, there is almost invariably a line of weakness developed prior to the moulting of the ephippium.

Having now seen how it is that the ventral portions of the valves become so easily detached from the rest of the shell when an ephippium is formed, we may very well ask ourselves why this process should take place. As the phenomenon is so common among the Cladocera there must be some fundamental necessity for it. I think the answer to this question is undoubtedly to be found in the fact that in the vast majority of cases it would be quite impossible for the anterior margins of the valves to be brought into contact if the ventral, and especially the anterior ventral portions of the valves, owing to their

very convex nature, remained in position. In other words, it would be impossible for the ephippium to form a closed covering for the egg.

In addition to the outer protective covering which has just been described, there are also some very delicate inner membranes which surround the egg, as indicated in fig. 1. They most probably consist of the moulted inner layer of the shell valves, and, so far as can be seen, do not appear to have undergone any special alteration. The resting egg itself—there is never more than one in any ephippium—is very largely composed of small globules of a dull greenish oily material. At the edges it is slightly translucent, but elsewhere opaque. It can readily be distinguished from a “summer” or parthenogenetic egg by its rather larger size and general opacity. Of course it is enclosed in a special covering of its own, the egg-shell properly so-called. In fig. 3 a broken egg-shell is shown, inside its protecting ephippium, after the hatching out of the young *Bosmina*.

It will be apparent from the foregoing description that the ephippium of *Bosmina* much more nearly approaches the homologous structures found in the majority of the *Lynceidæ* than it does those of the *Daphnidæ*. It is, in fact, scarcely worthy of the name of an ephippium, as that word is commonly understood, but would be more correctly designated as a proto-ephippium, a term I have already employed for these less highly developed types of protective egg-coverings.—*Quekett Club*.

On the Resolution of *Amphipleura Pelleucida* with a Dry Lens and Axial Illumination.

A. A. MERLIN, F. R. M. S.

Many members of our Club have been long familiar with the structure of *Amphipleura pelleucida* as revealed by oil-immersion objectives of the highest class and aper-

ture. The point to which I now beg to call your attention is the accomplishment of the resolution of normal specimens of this diatom by means of Zeiss's dry 4 mm. apochromat, and 5-6ths solid axial cone from Powell's adjustable apochromatic condenser.

I was led to attack the *A. pellucida* with the above specified optical arrangement through having remarked the great strength of the resolution yielded by some realgar-mounted specimens under the Zeiss 3 mm. of N. A. 1.4 and a solid axial cone of about N. A. 1.2 from an oil-immersion condenser. I must confess that the exact theoretical resolving limit of an object glass of N. A. .95, as given in the table on page 85 of Carpenter's "The Microscope and its Relations" (Seventh Edition, Edited by Dallinger, 1891), had at the time escaped my memory, otherwise it is extremely improbable that any such attempt would have been made.

It was found, however, that in actual practice the 4 mm., used in conjunction with a 27 compensating ocular, with which eyepiece the image remained perfectly sharp, would steadily show the fine transverse striae on realgar mounts, although the lineation was much fainter than that revealed by oil-immersion lenses of large aperture.

The resolution of valves in realgar having been accomplished, dry and balsamed specimens were next examined, and to my very considerable surprise, both proved resolvable with the 4 mm. and 5-6ths axial cone. In balsam the striae appear as extremely faint, but clean, grey lines of great fineness. Although most faint and difficult, they have been held with perfect certainty for short intervals, slightly averted vision proving of material assistance in this instance.

In order to satisfy myself that the true striae are indeed rendered visible by the 4 mm., a valve has been first arranged to exhibit them under the lens, an oil-im-

mersion being afterwards substituted, when the lines have been found to be identical, and of the same fineness and distance apart with both objectives, the only difference being in the strength of the resolution afforded by them.

The significance of the above results is at once apparent on turning to the aperture table, where we find that N. A. $\cdot 96$ is given as the *limit* of resolution of the *A. pellucida*; hence it would appear that the Zeiss 4 mm. of N. A. $\cdot 95$ (nominal), illuminated by a 5-6ths solid axial cone, is in practice capable of revealing structure just within the theoretical resolving limit of a lens of N. A. $\cdot 96$, and also that this resolution is attainable not only in media of high refractive index, but also in balsam and with dry mounts.

Now the 4 mm., although its guaranteed minimum N. A. is only $\cdot 95$, as a matter of fact is quite likely to possess a N. A. of $\cdot 96$, or even one slightly in excess of this, so that theoretically, without any deduction for technical imperfections, it would be just capable of resolving the *A. pellucida*; but that this theoretical limit should be actually attained by a lens with strictly axial illumination, and on specimens mounted in media of both high and low refractive index, cannot but be regarded as a very extraordinary and interesting result, it having been hitherto considered that the transverse striae of the *A. pellucida* are in actual practice only just discoverable with the dry achromatic lenses of N. A. 1 $\cdot 0$, and that only on specimens mounted in a medium of about 2.4 refractive index when illuminated by oblique light in one azimuth along the valve.

Perhaps not the least interesting and satisfactory outcome of these observations is the indication that a dry lens is capable of working to its full theoretical capacity on balsam-mounted objects, the resolution only becoming more conspicuous in media of higher refractive index.

In addition to the *A. pellucida* many other forms have

been recently studied with the 4 mm. and a 5-6ths solid axial cone. The most difficult structural features have not been seen with a lesser cone, but I do not assert that they may not possibly be so resolved, although the results of my observations have strongly inclined me to the belief that, with axial illumination, structure just within the capacity of the lens employed can only be seen with a very large cone. It has appeared to me that closing down the cone, while greatly strengthening the contrast of the coarser, causes the finer detail to disappear altogether, and materially reduces the separating power of the objective. With reference to this matter the following experiment may prove interesting:—Arrange a Cherryfield *Navicula rhomboides*, mounted in a mixture of monobromide of naphthaline and balsam, under a good semi-apochromatic $\frac{1}{4}$ " of N. A. .77, and 27 ocular, so that the valve shall lie longitudinally along and on the sharply focussed edge of the lamp flame. With slightly under $\frac{1}{2}$ cone the longitudinal striae will appear conspicuous throughout the entire length of the valve, while the closer transverse striae, although they may be seen to a certain extent, are far less satisfactorily defined, no thoroughly clear separation being apparent. Now replace the smaller by a 5-6ths cone. The coarse strongly-defined longitudinal striae disappear, and at the first glance all structure may seem to have disappeared with them, but a little careful scrutiny will reveal the presence of a faint dotted resolution, the transverse divisions of which are as fully and cleanly shown as the longitudinal.

I am aware that the results dealt with in this paper can not meet with general acceptance until they receive confirmation at abler hands than mine, nor indeed would it be desirable that they should be so accepted, involving as they do important theoretical considerations, until independent practical experience shall have placed their truth beyond doubt.

The subjoined notes on some of the forms lately examined with the 4 mm. may be of interest. A very large central solid cone has been invariably employed in conjunction with either Gifford's or the beautiful new acetate of copper screen.

Nitzschia curvula Sm. This diatom is mounted next to *Amphipleura pellucida*.

Grun. Moller's balsam type slide. Transverse striae extremely faint and difficult. A delicate object even with N. A. 1.3 and 1.4.

Nitzschia linearis and *N. obtusa* Sm. In balsam. The former very faintly resolved into transverse striae, the latter not so difficult. Dr. H. Van Heurck, in his "Synopsis des Diatomees," gives *N. linearis* as having 27 to 30 striae in 0.01 mm. (25.399 mm. = 1 inch), and *N. obtusa* 26 to 27 in 0.01 mm. *N. sigmatella* Grun., is given at 25 to 26 striae in 0.01 mm., but the specimen of this form on the type slide has much finer structure than *N. linearis* and *N. obtusa*.

Nitzschia sigmoidea Sm. Moller's dry "Probe-platte"—25½ to 26 striae in 0.01 mm. according to Van Heurck. This is remarkably easy with the 4 mm., the striae presenting a beaded appearance. They can be certainly seen with the 12 mm. apochromat of N. A. .65, so do not probably, in this instance, exceed 55,000 to the inch. A specimen in balsam is also very easy with the 4 mm.

Nitzschia sigma Sm. Van Heurck gives 22 striae in 0.01 mm. Distinctly dotted in balsam, and very easy in mixed monobromide of naphthaline and balsam.

Grammatophora oceanica Ehrenbg.—*G. subtilissima*. Moller's dry "Probe-platte." Resolved into transverse striae. Van Heurck gives 30 striae in 0.01 mm. for the *G. oceanica* var. *indica* Grun., and 30 to 31 for the *G. oceanica* var. *novaezeelandiae* Grun. Some specimens of *G. subtilissima*, however, are finer, running at about 88,000 to the inch.

Navicula crassinervis. Striae 34 to 35 in 0.01 mm. according to Van Heurck. This has proved a most delicate object with the 4 mm., both dry and in realgar. With N. A. 1.3 and 1.4 realgar mounted valves are sharply resolved into dots, but the transverse striae have alone been seen with the dry lens.

Hyalodiscus subtilis. In a mixture of monobromide of naphthaline and balsam. Dotted structure on outer zone well seen, although faint and difficult near the edge of the disc. In balsam mounts the structure appears still fainter, but nevertheless may be traced nearly to the outer edge, where it runs at about 76,000 to the inch.

Surirella gemma Ehrbg. In realgar the beading has been seen beautifully defined with the valve arranged longitudinally on the sharply focussed edge of the lamp flame. Specimens mounted dry, in balsam, and in quini-dine, have been also examined, but their complete resolution has proved a much more difficult matter.

Colletonema vulgare. Moller's balsam type slide. This has been most carefully studied with the 4 mm. The resolution is very faint, and requires particularly exact focal adjustment, but when once seen it can be held fairly steadily without any great difficulty. Dr. Van Heurck writes of this diatom, "Stries fines, delicatés, les moyennes faiblement radiantes, les terminales parallèles—environ 34 en 1 c. d. m.; les stries medianes plus fortes, plus écartées, 24 en 1 c. d. m. et plus radiantes."

Navicula major. Moller's balsam type slide. The full resolution of the structure of the bands on the hoop of this diatom is by no means easy, even with the Zeiss 3 mm. apochromat of N. A. 1.4. Notwithstanding this, the resolution is carried very far by the 4 mm., the striae appearing remarkably black, crisply defined, and well separated, their beaded nature being quite recognizable, although not so fully revealed as with the oil-immersion. On this specimen the striae alone are just visibly separat-

ed by the 12 mm. apochromat, 5-6ths axial cone, and a Huyghenian eyepiece magnifying about 45 times, the 27 compensating ocular not proving sufficiently powerful for the purpose with this objective.

Larval Water-mites on Aquatic Animals.

C. D. SOAR, F. R. M. S.

In a paper on Hydrachnidae, read in 1896, (*Journ. Q. M. C.*, Vol. VI., p. 318), I mentioned that I wished to make myself familiar, as far as possible, with the larval forms of water-mites, and by a systematic search among all kinds of our pond-life to find out upon what creatures these larvae occurred, and if the same species was always parasitic on the same host. Since then I have collected and examined a great many aquatic insects, etc., but the results so far have been rather poor. They have, however, been considered sufficiently interesting to put on record.

One of the most common aquatic insects upon which to find the larvae of Hydrachnidae is *Corixa geoffroyi*. I have found a great number of these, and some of them I have succeeded in keeping alive long enough to allow the red globular water-mite larvae to drop off and become free-swimming. The latter always turned out to be the nymphs of one of the species of the genus *Hydrachna*.

In September, 1898, on the Norfolk Broads, I took a number of water-boatmen, *Notonecta glauca*, afflicted with the red globular parasites. I brought some of them home, but, although I kept one or two alive for a long while, I did not succeed in getting any of the larvae to arrive at the next stage. In the spring of 1899, I again paid a visit to the same neighborhood, and succeeded in capturing some more water-boatmen. A number of these were brought home alive, as before, and this time I was successful in getting some of the red globules attached to the legs and body of the water-boatmen to become free-swim-

ming in the nymph stage. These again all turned out to be a species of the genus *Hydrachna*. By comparing the size of the red larvae found on *Notonecta glauca* in the autumn of 1898 with those found on the same form at the same spot in the spring of 1899, I have come to the conclusion that the water-mite larvae remain attached to their hosts for a whole season—namely, from the summer of one year until the spring of the next—and the fact that those I found in the autumn did not undergo any alteration helps to strengthen this opinion.

I have further found two small yellow pear-shaped larval water-mites on the larval form of a gnat, and also one on an *Ephemera* larva, but I have been unable to rear them.

I have found also that the water-scorpion, *Nepa cinerea*, is a favorite host with some species. But I have not been able to keep any alive long enough to find out to what species of water-mite the larvae belong. In Epping Forest I took a specimen of *Ranatra*, literally covered with red water-mite parasites of all sizes. This I succeeded in keeping alive until ten specimens became free-swimming. They all turned out to be nymphs of *Hydrachna globosa* Geer. But the most curious find, perhaps, in this connection, has been a small fish from a pond on Earlswood Common with two larval forms of water-mites attached, which I take to belong to a species of *Arrenurus*.
Quekett Club.

Viewing Diffraction Spectra.

J. REINBERG, F. R. M. S.

It is a matter of common knowledge that the diffraction spectra, which an object under the microscope gives rise to, may be observed by removing the eyepiece and looking down the tube. But unless the eye is kept perfectly steady, which is difficult, they shift and change about. For this reason Dr. Johnstone Stoney recommended look-

ing at them through a pinhole near the eyepiece, a method which I followed for some time. This, though it does away with the shifting, reduces the light very much. It is also possible to view the spectra by screwing an objective into the lower end of the sliding draw-tube, with eyepiece in position at the upper end, and then focussing down on to the upper focal plane of the objective, but this is a cumbersome business. Latterly I have employed a method which is exceedingly convenient and efficient. The diffraction spectra, as is known, are not only formed in the focal plane of the objective, but are reformed just above the eyepiece, and may there be viewed by means of a lens. So I have mounted in a short tube the objective of one of the cheap toy microscopes, which is in effect a lens of about a $\frac{1}{4}$ inch focus stopped down to an actual aperture of about 1 mm. The diffraction spectra ocular, as we may call it, when placed on the ordinary eyepiece of the microscope, on the cap of which it fits shows the spectra splendidly, magnifying them at the same time. It gives plenty of light, and the spectra can not shift. I can strongly recommend the arrangement to those who cultivate the useful habit of studying the spectra, *i. e.*, the optical effect produced by an object, as well as the object itself.—*Quekett Club*.

Sketch of J. D. Whelpley.

Born at Battle Creek, Mich., May 24th, 1861, Dr. Whelpley has just turned 40. To enumerate even the larger portion of the things which he has done during the comparatively few years of his existence would fill a volume, so no attempt will be made in this slight sketch to touch his career except at the high places. To show the strength of heredity it may be well to state in the first place that the subject of this notice is descended from a family of physicians, his father, grandfather and great-grandfather having practiced

medicine. From his maternal side, the Doctor inherited a love for literature. His mother's family produced many politicians, his maternal great-grandfather having been one of the framers of the constitution of Wisconsin, the inkwell from which that famous document was written being now in the Doctor's possession. This ancestor was once a candidate for governor of Wisconsin, on the losing side. The

famous Salmon P. Chase was a relative of Dr. Whelpley's mother.

Young Whelpley's education was acquired in the schools of his native state, including the college at Otsego. When hardly more than a boy he tried his hand at teaching a country school, with what success may be judged from the fact that he is yet a teacher. Before moving to St. Louis in

1881 to take advantage of the opportunity presented by the city to acquire a college education in pharmacy, the future president of our leading pharmaceutical organization had received his first instructions in bottle washing and window cleaning in Michigan, and had also practiced pharmacy in Illinois.

Applying himself to his studies with his usual diligence, the student was graduated by the St Louis College of Pharmacy in 1883 with the highest record which had been made at that institution up to that time, and won the gold medal for general excellence. While at college his irrepressible predilection for teaching compelled him to form a quiz class—the first in the history of the college—of which he was master. Upon his graduation he became a regular quiz-master of the college and has continued his connection with the teaching faculty ever since, being now professor of microscopy.

When but sixteen years old, Mr. Whelpley began to read medicine, but did not go about it seriously until many years later. In 1890 he was graduated by the Missouri Medical College, ranking third in a class of 117, notwithstanding the fact that he was looking after outside interests while carrying on his studies.

Five years before he had gained his degree of M. D. Dr. Whelpley began to teach in the medical college mentioned. After his graduation he became a member and secretary of the faculty. For ten years he filled the chair of histology, physiology, and microscopy, and then, upon the merging of Missouri and St Louis Colleges into the Washington University, he became, and still is, professor of materia medica and pharmacy in the latter. He is also professor of the same two branches in the dental department of the university. The Doctor, or Professor, as he should be known in this connection, has a faculty of being able to impart to his students any knowledge he possesses. He is popular with the boys, and is able to be on the most friendly terms with-

out in any degree losing any of his own or of their respect.

In addition to his other work as a teacher the Doctor delivers free popular lectures on scientific subjects during the winter.

This many-sided man under discussion is a member of the American Medical Association, as well as of his state and city societies, and also of the local Academy of Science, and Historical Society. He was a delegate to the Pharmacopœial Convention in 1890, and again in 1900, being elected secretary of the convention the latter year. He is also active in the alumni associations of the colleges of which he is a graduate, and is well up in Masonry and Odd Fellowship.

The literary work of the new president began when he was young. He acted as correspondent for the newspapers while still a boy, and also edited a college paper. Soon after going to St. Louis he became the pharmaceutical editor of the St. Louis Druggist. The paper became the National Druggist, and he became the editor. In 1890 he left that paper and assumed entire charge of Meyer Brothers Druggist a position which he still holds. He has published Curtman's Lecture Notes, and Whelpley's Therapeutic Terms. His contributions to the statistical knowledge of the use of the metric system have been large.

In 1892, Dr. Whelpley and Miss Laura Spannagel, the daughter of a well known St. Louis banker, were married.

While making no public pretense to scientific attainment Mrs. Whelpley took a post-graduate scientific course at Cornell and is well versed and much interested in her husband's work. Their pretty home is a veritable museum of archæology and microscopy. In it is a large library of microscopical works, about 8,000 rare microscopical specimens, a large and unique collection of Indian relics and like historic and prehistoric things. This home is open to students of science, some coming from Europe to visit it and see archæological specimens which cannot be duplicated in any of the museums of the world.

A Murder Trial in Washington.

A Mrs. Bonine is on trial for the alleged murder of James Seymour Ayres in his bed-room at 2 o'clock one morning last May. She admits that she alone was with him at the time of shooting, but claims self-defence. Curiously, it is to her interest to prove blood on her garments to an extent that will show that there was a hand to hand struggle. Her expert, Dr. Sterling Ruffin, testified as follows:

Q. What are the principal tests for blood spots?—A. There are three tests in particular—the Wyeth, microscopic, and Haeman-crystal tests.

Q. Are all in vogue at the present?—A. Yes, sir. All are in vogue and are recognized by the scientific world as reliable.

Q. Are they all conclusive?—When applicable; yes, sir.

Q. Did you make any experiments as to whether there was any blood on Mrs. Bonine's wrapper?—Yes, sir.

Q. Where?—A. In Dr. Schaeffer's office.

Q. Who was present?—A. Dr. Schaeffer and Dr. Carroll at one time and Dr. Schaeffer, Dr. Carroll, and yourself at the other time.

Q. Did Dr. Schaeffer observe the experiment?—A. Yes, sir.

Q. What did you find regarding the condition of the wrapper?—A. I found several rips and tears.

Q. Did you inflict or enlarge any of these?—A. No, sir; not by the fraction of an inch.

Q. Did you examine the wrapper for blood spots?—A. Yes, sir. I took pieces of the wrapper from several places for the purpose of examining them.

Q. Where from?—A. I took one piece from the front and one from the back of the lining of the green velvet yoke and various other specimens. Some consisted of the velvet and some of the brown material of the wrapper.

Q. What was the result of your examination of the two specimens taken from the yoke?—A. I found blood on both.

Q. What tests did you use?—A. I used the Wyeth, microscopic, and Haeman-crystal tests.

Q. What did they show?—A. Each showed there was blood on both specimens.

Q. Were all of the tests applicable and conclusive?—A. Yes, sir.

Notes on Microscopy.

M. I. CROSS.

THE MICROSCOPICAL EXAMINATION OF METALS.—It is a little singular that a study which has assumed such great importance as the examination of steel and iron under the microscope has done during recent years should not have received any treatment whatever in so exhaustive a work as the new edition of "Carpenter on the Microscope." It is a highly technical and important subject and has become an absolute essential in all iron and steel works. In fact, there is probably no factory of standing that is not equipped with suitable instruments both for observing and photographing.

Although much information regarding the chemical constitution of the metal is disclosed by the microscope, it is in ascertaining the mechanical properties that the special value of the examination lies.

For instance, the structure of steel varies with the different degrees of hardness and the amount of heat to which it has been subjected, and it is possible to gain definite information concerning the suitability of the metal for the purposes for which it is to be used by means of the microscope.

In the manufacture of guns the microscope is invariably resorted to, and it can be definitely determined before the manufacture is proceeded with whether the metal is suitable for the purpose, or any defect has taken place in the heating or quenching which would render the gun unsafe or unsatisfactory.

Engineers can detect flaws, blow-holes, defective welds, etc., and in many ways are able in an early stage to avoid the trouble incident to the use of imperfect metal in the finished article. Microscopes for the exclusive purpose

require no substage apparatus or mirror, and although the completed stand is usually employed, the demand has become sufficiently marked for makers to produce special instruments in which a large mechanical stage is provided, but no fittings beneath the stage. Among these are Reichert, of Vienna, C. Baker, of London, and Queen, of Philadelphia. In all of these the vertical illuminator plays an important part; some observers preferring the pattern with a prism, others the cover-glass reflector, while many employ both, finding that each pattern is advantageous according to the structure examined.

When the light and illuminator have once been adjusted, it is important that no movement of the body of the microscope takes place, or the illuminating would have to be re-set. To obviate this, these special microscopes by Queen and Baker have rackwork focussing adjustment to the stage, together with levelling screws, so that any want of parallelism in the piece of metal may be corrected, and the face set at right angles to the plane of the objective. It will be seen from this that the subject has received careful consideration, and that suitable means are available for accurate work.

The metals themselves that are to be observed have to be prepared with great care; the processes are technical, and vary with the purpose of the examination. Generally a small sample block is taken, and cemented to a piece of glass. It is then ground and polished on a series of emery papers, and finally with a very fine polishing material such as rouge, until no scratches can be detected.

Although the harder portions can be in many instances seen at this stage, chemical means have to be resorted to, to differentiate the structure, the action being unequal on the different constituents, and it is by the treatment with such chemicals—nitric acid and liquorice juice being among the most important—that the chemical composition is detected. Many of the constituents have received distinctive names, among them being:—

Ferrite, which is the name given to pure iron.

Cementite, representing the iron carbide in steel.

Pearlite, a mixture of cementite and ferrite.

Martensite, the structure of quenched steel.

Austenite, a name given to structure which is produced in steel in which there is a high proportion of carbon.

There is vastly more to be learned of this interesting subject, and it is a field in which the amateur could with interest and profit make investigations.

MULTIPLIED IMAGES IN DIATOMS.—Happening to hold a needle over the mirror of the microscope while a slide of *Triceratium* was under examination, I noticed that its point appeared dimly in each of the interspaces, and on racking the body of the microscope slightly upwards in same manner as is necessary when observing multiplied images in the cornea of the eye of a beetle, I noticed that it became distinctly sharp. I then placed a piece of black paper cut in the shape of a cross on the mirror, and with a 1-6 in. objective saw it sharply displayed, although on a much smaller scale than in the eye of beetle.

Experiments were then made with *Coscinodiscus* and other diatoms, and the same result was shown. This would seem to indicate that these interspaces are lenticular in shape, and it may be that with this knowledge further light may be shed on the complex question of the ultimate structure of some of the Diatomaceæ.

Subscriptions for 1902

The published price of this Journal for 1902 will be \$1.20. From this, a discount of twenty cents will be made for prepayment coming from the subscriber direct or through any agent or intermediary the subscriber may select. Whenever we have to send bills we shall charge the published price \$1.20. We prefer not to deal through middlemen and therefore cannot hereafter, as many periodicals do, make a larger price in order that middlemen may get their allowances. We wish to net a dollar in advance without discount or trouble of sending bills and cannot put a premium on round-about methods which benefit neither the subscriber or the publisher. Yet as "agents" will be used and if used ought to be remunerated we publish the price at \$1.20 and so authorize them to charge that price. Out of it they must remit to us one dollar.

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